Editorial Staff
New York
V. T. Houghton
W. G. Bowman
C. S. Hill
F. W. Herring
H. W. Richardson

Engineering News-Record

A Consolidation of Engineering News, Engineering Record, The Sanitary Engineer, and The Contractor

F. E. SCHMITT, *Editor*

Chicago
Editorial Staff
W. W. DeBerard
San Francisco
N. A. Bowers
J. I. Ballard

Willard Chevalier
Publishing Director

Contents for March 23, 1933

VOLUME 110, NUMBER 12

Copyright, 1933, by McGraw-Hill Publishing Company, Inc.

Gantry Crane Erects 60-Ton Stone Columns..... 365
BY GEORGE S. MERTS

Coordination of Transportation Needs to Be Fostered..... 366
BY KEY PITTMAN

Engineering and Construction in the U. S. Navy..... 368

Trends in Highway Traffic in the New York Region..... 372

Concrete Water Tunnel Inspected After 25 Years..... 374

Difficult Sewer Tunnel Built by Welfare Labor..... 376
BY WILLIAM P. MORSE

Structural Damage in the Long Beach Earthquake..... 378

Annual Meeting of A.R.E.A. in Chicago..... 382

Book Reviews.....384 Editorials .....386 Letters 385
News .....388 Unit Prices.....393

Published every Thursday. Price 25c. per copy. Subscription, domestic, Central and South America, $5 per year. Canada, including duty, $7.50. Foreign, $9 or 45 shillings. Entered as second-class matter April 11, 1917, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A. Cable Address "MCGRAWHILL, New York." Member A.B.P. Member A.B.C.

McGRAW-HILL PUBLISHING COMPANY, INC., 330 WEST 42D STREET, NEW YORK, N. Y.

Editorial and Publishing Office: 330 West 42d St., New York; 520 North Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, London, W. C. 2, England. Branch Offices: Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Greenville, S. C. James H. McGraw, Chairman of the Board; Malcolm Muir, President; James H. McGraw, Jr., Vice-President and Treasurer; Mason Britton, Vice-President; Edgar Kobak, Vice-President; H. C. Parmelee, Vice-President and Editorial Director; Harold W. McGraw, Vice-President; C. H. Thompson, Secretary.

Weld Buildings at Less Cost

STRUCTURAL CONNECTION FOR STEEL ERECTION ELIMINATING FIELD BOLTS

(Protected by patent pending)

The use of this connection not only eliminates field bolting, but also shop punching and drilling of members. The pins, easily driven into place, not only hold the members securely for field welding, but reduce materially the plumbing and guying of the structure.

Eliminate the Noise of Riveting and at the Same Time Cut Erection Costs By Using the

LEAKE

BOLTLESS CONNECTION

SAFETY of arc welded buildings is definitely established.

DESIRABILITY of arc welded buildings with the reduction of noise in their construction is equally definite.

NOW, ECONOMY of arc welded buildings is obtained by doing away with the expense of field bolting.

The LEAKE *and* NELSON CO.

CONTRACTING • CONSULTING • STRUCTURAL • WELDING

Main Office and Works
203 Ash St., Bridgeport, Conn.

Engineers

Pennsylvania Representative:
Snow-Weaver Industrial Management, Inc.,
Harrisburg, Penna.

Licensee under U.S.A. patents and patents pending controlled by A. G. Leake

Engineering News-Record

Vol. 110 New York, March 23, 1933 No. 12

Erecting 60-Ton Stone Columns.....365
Transportation Coordination 366
Construction in the U. S. Navy.....368
Highway Traffic—New York Region..372
Inspection of a Concrete Water Tunnel.374
Welfare Labor Builds Sewer Tunnel..376
Long Beach Earthquake.....378
A.R.E.A. Convention 382
Book Reviews 384
Editorials 386
News of the Week 388
Unit Prices.....393

Gantry Crane Erects Heavy Stone Columns

Monoliths weighing 60 tons each were set in record time on the four sides of the new building of the Mellon Institute of Industrial Research, in Pittsburgh

By George S. Merts
Engineer, Alexander Howie, Inc., Cleveland, Ohio

THE PROBLEM of setting sixty-two stone columns weighing 60 tons each on the new building of the Mellon Institute of Industrial Research in Pittsburgh occasioned the development of an unusual erection procedure in which a field-assembled gantry crane played a conspicuous part, placing all of the columns in less than seven weeks without a mishap of any kind. The columns are believed to be the largest of their type in existence.

The building, of classic design, is a trapezoid in plan about 300 ft. long on three sides and 230 ft. on the fourth side. The columns, set on about 13-ft. centers, stand in front of the windows on the four sides of the building. They are 5 ft. 3 in. in diameter, 36½ ft. long and are of a single piece of limestone. Transportation of the columns to the building site was therefore the first important part of the construction task.

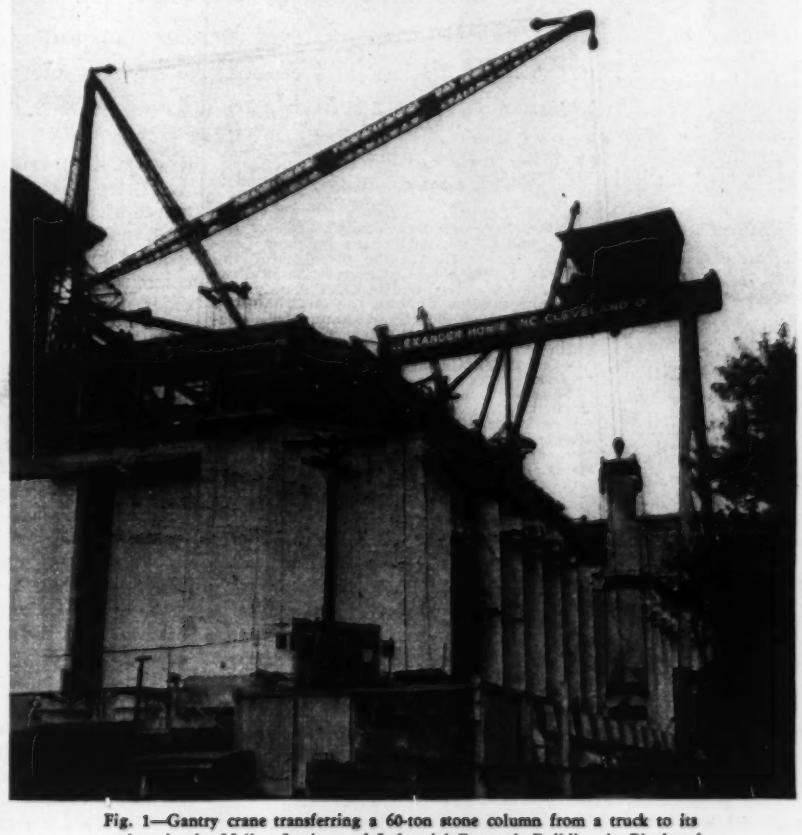


Fig. 1—Gantry crane transferring a 60-ton stone column from a truck to its place in the Mellon Institute of Industrial Research Building in Pittsburgh.

At the railroad yards the columns were unloaded from flat cars by rolling them onto cribbing and thence onto trucks and trailers. Although the trailers had four 12-in.-wide wheels on one axle, it was necessary to build a temporary road of two layers of 8-in. railroad ties to carry them in the unloading yard. Then in moving the columns through the streets of Pittsburgh extreme care had to be exercised; steel plates ½ in. thick were used over all manholes that had to be crossed. At

the job 100,000 ft. of timber and hardwood plank were used in another temporary road built entirely around the building. Construction of this road was complicated by a deep fill next to the building wall, requiring special support of the inside edge of the roadway. Sheetpiling being already in place, a 12x12-in. timber bent was set on top of this (Fig. 2), a 1-in. steel plate with two angles attached being spiked to the bottom of each leg of the bent to prevent the sheeting from cutting into the timber. This road permitted the trucks to deliver he columns to their proper locations.

The erecting apparatus consisted of

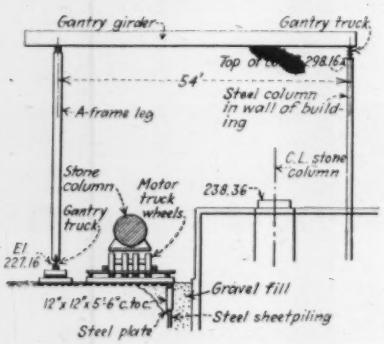


Fig. 2—Cross-section sketch of erection equipment for setting stone columns.

a gantry crane spanning 54 ft. over the temporary road from the exterior line of steel building columns (Fig. 1). The crane girders consisted of two 36-in., 300-lb. sections. At the building end these girders rested on a truck running on a temporary 15-in., 85-lb. beam bolted to the top of the permanent building columns. Two 3x4-in. angles bolted on the top flange of this beam formed a trough that confined the flat wheels of the truck. The outside end of the 36-in. girder beams rested on a 73-ft.-high A-frame, 21-in., 62-lb. sections being used for batter legs. Adjustable extensions were provided at the bottom of the legs so as to minimize the amount of cribbing required. Two-wheel trucks at the bottom of each leg traveled on a 100-lb. rail set on the cribbing (Fig. 2).

The hoisting mechanism consisted of an ordinary 125-hp., three-drum electric hoist mounted on a four-wheel steel carriage. Two drums of the hoist were used to propel it along the crane girder, while the third drum hoisted the load, using 1-in. cable reeved in thirteen parts on two six-sheave blocks.

To provide a means of lifting the columns from the trucks, two cast-steel bands of two segments each were bolted on, one just above the center of gravity and the other near the bottom of the column (Fig. 3). A ½-in. layer of lead was used as a lining on the inside of the bands to prevent slipping. The two bands were connected with two 2½-in.-diameter rods. Two pins extended out from the upper band and engaged two eyebars suspended from a balance beam which was hooked to the main falls. The upper end of the column was picked with an auxiliary falls from a stiff-leg derrick on top of the building. By picking the column off the truck in a horizontal position with both sets of falls and then slackening the auxiliary falls the column was turned to a vertical position. After raising the column to the required height, the overhead carriage traveled in toward the building and the column was lowered into place. The average time required to set a column after its arrival on the job was 35 min. During the major portion of the job four columns were set per day. At the corners of the building, after the line of columns along one side had been set, the gantry crane was dismantled and re-erected on the next side, using the stiff-leg derricks located on the roof.

The stone-setting was done by Alexander Howie, Inc., of Cleveland, Ohio.

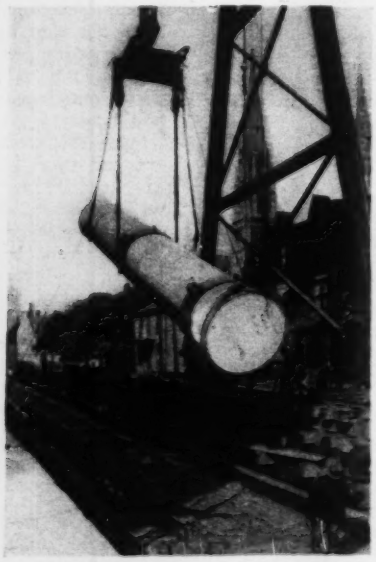


Fig. 3—A special clamp and balance-beam apparatus used in handling the columns lifted them from a horizontal into a vertical position ready for setting.

Need for Coordination in Field of Transportation

The public deserves whatever form of transport gives it the most efficient and economical service—German practices cited as applicable to railroad service here

By Key Pittman
U. S. Senator from Arizona

SENATOR PITTMAN now occupies one of the most influential positions in the new Congress. He is the senior member of the Senate Interstate Commerce Committee and foregoes the chairmanship only because he prefers to take the chairmanship of the Foreign Relations Committee. Because of his position in the commerce committee his views on the coordination of rail and motor transportation are of special interest.

The wide use of freight containers in Germany is cited by Senator Pittman as an example of a practice that should be adopted here. Despite considerable opposition, such containers now are used extensively in the Eastern part of this country, where conditions make their use economically justified. Doubtless their use will be extended when financial conditions permit. —EDITOR.

THE SUPREME test of every mode of transportation must be in its efficient and economical service to the public. American progress can be most conveniently measured in the degrees with which easier and more speedy transportation, with lowered costs, has been brought with the passing years into the industrial, business and social life of the country.

Motor vehicles and good roads have made a tremendous contribution to the American people, just as the locomotive and steam railroad was a great forward step from the difficult process of traveling by wagon or slow-moving boat, and the electric interurban line speeded up transportation between urban communities, and between towns and cities and their suburban neighbors.

The country has need for both railroads and motor vehicles. and in their coordinated and unified service is to be found the proper and most effective function of both. Without adequate coordination they have provided already a surprisingly cheap and efficient transportation service, the benefits of which are to be visualized in the saving of time in travel, the more rapid turn-over in goods, less costs in crating and handling goods, more efficient employment of capital and a reduction in the need of borrowed capital in doing business.

It is in the public interest that intelligent efforts should be made to coordinate and unify railway and highway service—not by subordiating one to the other or bringing one under the domination and control of the other, but by making each an efficient and essential part of the other in the rendering of public service.

The highway system owes its development in a great measure to the federal highway act of 1916. This law defined certain minimum highways and standardized them among the states in building roads, especially in promoting safety factors in their construction and in coordinating the roadbuilding programs of the states into a single nation-wide effort.

Before the construction of such roads was undertaken it was not uncommon to find in the Western states a fertile valley 60 or 70 miles removed from a railroad in which people were living under conditions as primitive as did the first pioneer settlers. Costs of transportation to and from the railroads were so great that these valleys had no economic value whatever.

But today, with well-built roads, these distances are covered in two or three hours, and many of these valleys have become great vegetable and fruit-producing areas, and others are given over to dairy products and poultry. In fact, Los Angeles, with its thickly settled surrounding community and land values that make farming unprofitable, is largely supplied with fresh foodstuffs from such distant valleys.

While railroads have unquestionably suffered in their passenger and freight business as a result of the development of paved roads and the extensive use of motor vehicles, it must be admitted that the latter are bringing much additional traffic to the rail carriers. And this handicap to the railroads should be neither permanent or prolonged, for both in their broadest range of public service are essential to the country, and their facilities should be rapidly coordinated to provide a larger and fuller measure of service.

Highway building stimulated

Good roads have had a great impetus in the extensive use of trucks. They have long since ceased to be simply a convenience for pleasure or passenger cars. Returns to the states in license fees and gasoline taxes from trucks and buses have provided great sums for the building of roads—a load that passenger vehicles alone could not have shouldered.

Coordination of highway traffic with railroad facilities thus becomes a question of pressing moment. Germany has met this condition of multiple transportation in an admirable way. She has coordinated the four methods of transportation—air, railroads, highways and waterways—without favoritism to any one or two of them.

Coordination in Germany

While the German government owns the railroads, yet shippers have their preference — movement by airplane, motor truck, railway or waterway—and select their means of transportation according to the character and value of their consignment and the element of time. Neither the railroads, motor trucks, airplanes or waterways are trying to put each other out of business.

Time is not an essential factor in the movement of certain types of freight, and naturally these types move by the slowest means and at the lowest rate.

The result is that German railroads do not compete for the movement of certain low-grade commodities. Neither are rail rates established on an artificial basis of long and short hauls, and they do not have such long and heavy trains and heavy roadbeds as are found in this country.

Freight containers that would correspond to a box car in this country, but are more nearly the size of the van of a motor truck, are loaded at a factory or warehouse and moved by motor truck to a railway platform. They are then lifted by a crane to a railroad chassis similar to a flat car here.

When this car reaches the container's destination, the container is lifted off and delivered to the consignee by motor truck. Possibly another container is put on the rail chassis in its place, and the train continues on its way.

This practice has far-reaching elements of economy and efficiency. The Germans do not use so many switch engines or engage in extensive switching movements or have great classification terminals, as are found on American railroads. Freight traffic from all directions is not poured into a single great terminal yard and, salt-shaker-like, redistributed and sent out again. The work incident to the movement of a freight consignment is infinitely less than it is in our own country.

American railroads have not yet reached this method of handling light and less-than-carload shipments. They are still thinking largely in terms of the transcontinental movement of freight, in building larger and larger locomotives and larger and larger cars and in laying heavier and heavier rails.

The German practice is more nearly approximated by our truck movement of freight. Yet undoubtedly American railroads will come to a method very similar to the German practice in handling much of their tonnage. This change, of course, will involve less heavy and expensive locomotives and freight equipment.

American equipment too large?

The question may well be raised whether commodity movement and freight traffic in the United States should continue to be taxed in rates in keeping with the costs of expensive and increasingly heavy equipment on American railroads. There can be no question about the present-size box car and freight locomotive representing an uneconomical investment for the volume and movement of many kinds of freight, and it is one of the items of expense that unquestionably has driven much of the freight movement to the highways.

Here a train must be broken before a car can be moved from it, and that car may be idle for two or three days. In Germany only the container is idle; the chassis continues in daily use, since both containers and chassis are of standard and similar design, and trains are operated from terminal to terminal almost without break.

There is no reason why motor-truck service should be curtailed. It represents a distinctly forward step for which the country has need and which it should have in the interest of efficient and economical transportation.

The fact that the railroads need help must be taken into consideration, no matter at whose door their troubles of the present may be placed. We cannot go now into the mistakes of the past. These roads are a great national institution, and their solvency and well-being affects the whole country.

Unquestionably the answer lies in the coordination of all modes of transportation, and that task should be constructively pushed and carried forward in a spirit of cooperation and sympathetic understanding.

Termite Exposure Tests

International termite exposure tests are being carried out by the U. S. Forest Products Laboratory in Australia, Barro Colorado Island (Canal Zone), Hawaii and South Africa. Test specimens of sap pine 2x4x18 in. in size were prepared in the laboratory and sent out in 1928 to be installed in soil known to contain termites. In 1931 some 500 similar specimens treated with a different set of chemicals were sent to Barro Colorado Island. Comparison of the results from the different stations shows marked difference. For example, nickel arsenate specimens are still sound at Barro Colorado Island, but in Australia all but one are either attacked or destroyed. On the other hand, coal-tar creosote specimens are sound in Australia and South Africa but are being attacked in the other two stations. Differences in climatic and exposure conditions and species of termites, in amount or distribution of preservative in individual specimens, in inspection methods and classifications used are believed to be accountable for the divergent results.

Results of the tests were reported by George M. Hunt and T. E. Snyder, of the Forest Products Laboratory, to the recent Chicago convention of the American Wood Preservers' Association. Before conclusions can be drawn several more years should elapse, according to the authors of the report. They also warn that the use of the data for commercial promotion of any preservative is not warranted. Ultimately, they state, a relation will be established between absorption and the life of the specimen, for nothing is infallible and sooner or later both termites and decay will locate and destroy the places in the wood that have not been penetrated satisfactorily.

Federal Engineering—Article III

Civil Engineering and Construction in the U.S. Navy

Design and construction of diverse structure in navy yards and bases is all handled by the Bureau of Yards and Docks—Many studies of value to the engineering profession are made in connection with the construction of marine structures

WHENEVER the Navy is mentioned, one's first thought is of ships and guns, torpedoes, aircraft and men. There is little general appreciation of the extensive plant ashore that is absolutely necessary in order to build, repair and take care of the offensive weapons and to house and train men of the Navy. Yet the fleet cannot operate without bases, navy yards, training stations, air stations, supply depots, gun factories, radio compass stations and ammunition depots; and for success in war these shore facilities are an essential part of the Navy.

Barracks built by the Bureau of Yards and Docks for enlisted men at Anacostia, D. C. Architecture of structures built at the naval bases is designed to harmonize with that of the surrounding region.

It is the duty of the Bureau of Yards and Docks of the Navy Department to design and construct these so-called public works of the Navy. Their variety is great, for among the facilities it provides are drydocks, marine railways, ship-building ways, quay walls and piers, shops, railroads, cranes, storehouses, barracks, hospitals, radio towers, fuel depots, magazines, power plants, flying fields and hangars. It furnishes such utilities as cranes, motor vehicles and fire-fighting equipment. It must repair all these facilities and operate the general services of the yards, such as the water, sewer, heating, electric and other power systems and the transportation systems, both rail and roadway.

This engineering work ashore is carried on under the supervision of the officers of the Corps of Civil Engineers of the Navy, a small corps of 109 members, all graduates of engineering schools and some with previous training at Annapolis and sea duty. The Chief of the Bureau of Yards and Docks is selected from the members of this corps. He has eight or ten officers of the corps as his assistants at the bureau in Washington. The other officers of the corps are sent to the various navy yards and stations or other localities where the bureau may be carrying on work, not only in the United States but in the Philippines, Guam, Canal Zone, Samoa or wherever the work may be. At each navy yard or large station the senior officer of the corps is the public-works officer, a member of the staff of the commandant of the yard or station. He has other officer assistants and usually a force of civilian technical assistants and a civilian working force for construction, repair and operation. He is the officer-in-charge for all Bureau of Yards and Docks work in his district; he operates the power plants and the transportation and power-distribution systems; he carries on minor construction and repairs with the force under him; he studies, with the other officers of the commandant's staff, the needs of the yard in order that it may fulfill its mission in providing for the fleet in peace and also in war; he obtains the data needed to enable the bureau to prepare the plans and specifications for contract construction, or he may be directed by the bureau to prepare such plans and specifications with his own technical force. This latter is an outgrowth of the recent bureau policy tending toward decentralization, rather than concentration of all design work in the bureau offices in Washington. The officer-in-charge may have his jurisdiction extended far beyond the site of his major activities. For instance, the public-works officer at the Puget Sound Navy Yard, near Seattle, Wash., is also the public-works officer of the Thirteenth Naval District, and as such has charge of bureau work at the air station, the ammunition depot and the torpedo station not far from the yard, and also such work at the radio and radio compass stations along the coast of the state of Washington and in Alaska. His activities extend into Bering Sea.

The public-works officers at Samoa and Guam have extra engineering duties also, under the naval governors of these islands, such as acting as judges of courts of equity and collectors of taxes, the issuance of building permits and fish-weir licenses, as well as the operation and maintenance of the transportation and communication systems of the islands.

For about fourteen years the officers of the corps were detailed to duty in charge of public works under the government of Haiti and did extensive work in developing the roads, schools, public buildings and other public works of this republic.

Anticipating future requirements

One of the most important duties of the Bureau of Yards and Docks and of the public-works officers is to anticipate the needs for shore development as the Navy alters and improves the type of ships, ordnance, ammunition and aircraft and introduces new processes of manufacture and methods of doing work. This involves close contact with the other bureaus of the Navy and even

with the fleet itself. The shore facilities must be kept in a high state of efficiency in order that requirements of the fleet may be promptly satisfied. The possibility of war must constantly be kept in mind. This introduces an element in the design of naval works that is not necessary in non-military construction. It is often the paramount consideration in the design, to which all economic considerations, as understood in civil practice, are secondary.

The bureau gives much study, in conjunction with the other bureaus and offices of the Navy Department, to the subject of preparation for war and what steps would be necessary in war to expand the shore facilities in order to meet the vastly increased demands of the fleet and the far greater number of men. The funds that are appropriated in time of peace do not permit the construction of all the facilities needed in war; but plans for these facilities must be made. Advance planning for procurement of materials for such construction is most essential, a lesson learned from the World War.

Civilian engineer service

Assisting the officers of the corps in their work is a civil service force, many of whom are highly qualified engineers and experts in various branches of bureau work. These civilians, some of whom have been in the service for many years, constitute a force whose help is invaluable because of their ability and long service and familiarity with the work and policies of the bureau. Due to the great variety of special work devolving on the corps and the frequent shifts of officers, these civilians become a highly trained group of engineers possessing the peculiar knowledge necessary in their naval work. They form the nucleus from which the corps could be expanded several fold in time of national emergency.

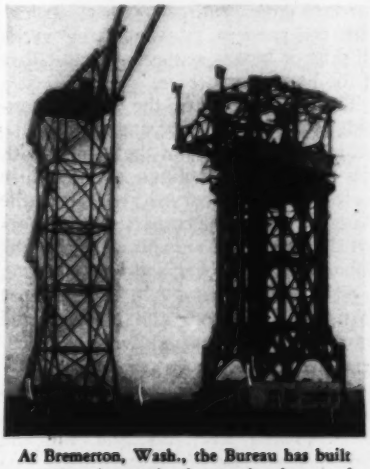
The extent of the routine duties of the Bureau of Yards and Docks other than design and construction, can be visualized from the fact that the public works and public utilities of the Navy, which the bureau must keep in repair and operating condition, have a value of $400,000,000. For the last two fiscal years expenditures under the bureau for mantenance, repair and construction aggregated $22,000,000, and in this period contracts for construction were made amounting to more than $21,000,000.

Emergency relief construction

Construction under the Bureau of Yards and Docks has played a considerable part in the endeavor of the federal government to furnish employment during the depression. In February, 1931, Congress authorized the expenditure of $7,799,000 for naval public-works emergency construction. Work under some of the projects thus provided was started the day after the appropriation

Submarine training tank at the submarine base, New London, Conn. A similar structure has been built at Pearl Harbor, T. H., for training men in underwater operations.

was made. Six weeks after the bill had passed, all major projects were under way or bids for contracts were being invited. In July, 1932, in the Emergency Relief Bill, Congress made $10,000,000 available for work under the Bureau of Yards and Docks. This work also was promptly started and has furnished employment at the various yards and stations for many men and indirectly for many others throughout the United States. These two relief funds were in addition to the regular appropriations for maintenance repair, operation and improvements. The Bureau of Yards and Docks promptly prepared its six-year construction program in accordance with the Employment Stabilization Act of 1931. The Emergency Relief Bill of July 21, 1931, above referred to, provided funds for carrying out a part of this program, and the bureau is prepared to proceed further with this important program whenever Congress authorizes it to do so and makes the necessary appropriations.



At Bremerton, Wash., the Bureau has built a 250-ton hammerhead crane for the use of the Navy.

Pioneer work by the bureau

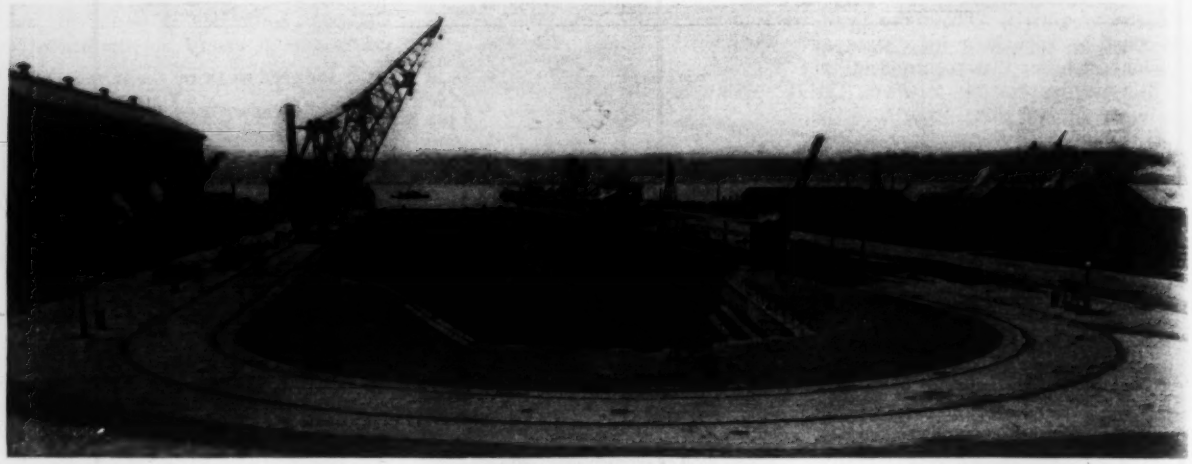
Much of the construction work of the bureau is designed to meet special naval needs such as are seldom encountered in civil life. In many classes of engineering the bureau has been a pioneer, much of its engineering construction having been among the first of its kind and the design and methods being of the most advanced modern practice. In such constructions as graving drydocks and floating drydocks, heavy piers and quay walls, radio towers, hangars for aircraft of all kinds, and mooring masts for airships, the Navy has been a leader in the engineering practice of the country. In such subjects as reinforced concrete, especially in the presence of sea water, foundation engineering, hospital construction, housing of men, and power distribution the officers of the Corps of Civil Engineers and their civilian assistants have done valuable pioneer work.

In carrying on its engineering duties the Bureau of Yards and Docks works in close cooperation with other engineering and scientific branches of the government. There is frequent contact with the Bureau of Standards, Department of Commerce, on matters involving tests of materials and on questions of new methods and practices. Officers and civilians of the Bureau of Yards and Docks are on many of the committees of the Federal Specifications Board. The Bureau of Reclamation was consulted, and that bureau designed and assisted in the construction of the dam at the Naval Ammunition Depot, Hawthorne, Nev., because of its expert knowledge and great experience in dam construction. The Bureau of Public Roads has been conducting analyses and compression tests of clays underlying the site of the new hospital in Philadelphia, Pa., and the Geological Survey gave careful study to the geology of the site. There is constant cooperation with the office of the Chief of Engineers of the War Department in connection with dredging of channels. The Bureau of Mines is referred to in problems connected with helium, oil wells, coal and other fuels.

The Bureau of Yards and Docks has done work of various kinds for other departments. It built several large hospitals for the Veterans' Bureau. It is constantly taking advantage of the special knowledge and facilities of the other branches of the government and frequently gives aid to these other branches in their problems when requested, in order to improve the standard of work done by the bureau, increase its usefulness and avoid duplication in government work and federal forces.

Special studies made

Either by itself or in cooperation with other branches of the government and



The drydocks at Bremerton, Wash., and at Charleston, S. C., have been extended to take the aircraft carriers Saratoga and Lexington. The 90-ft. extension to the Bremerton dock is here shown.

enginering societies, the bureau conducts such investigations as its interests and widely distributed field organization render advisable—as for example, a study of the action of marine borers on various kinds of wood, both untreated and treated; the effect of salt water on concrete, not only by observation of actual construction but by actually placing test pieces in water under varying conditions; the study and actual use under observation of many kinds of paints and other protective and preservative materials, of putty, various kinds of wire screening, steel sash, roofing and other materials used in construction. The studies and experiments are extended over a wide climatic range, from Alaska to the tropics, and are intended to serve not only the Navy but all interested engineers. Frequent requests are made of the bureau for engineering information based on its own experience, and this is freely given as far as the force available and the character of the information will permit.

Major construction operations

It would be impossible in a brief article to enumerate the construction projects of the bureau that are of interest to the engineering profession, but mention of a few now under way or recently completed will illustrate the scope and character of its engineering practice.

The Naval Air Station, Sunnyvale, Calif., is a good example, for it offered the opportunity to design and build a complete unit, comprising many classes of structures and engineering in great variety. When finished, this station will be the center of operations for navy airships on the Pacific Coast. The site of 1,000 acres is about 40 miles south of the city of San Francisco near the southernmost end of San Francisco Bay. The main feature of the station is a large airship hangar with mooring circles and a mooring and handling mast for the docking and ground-maneuvering of airships. Facilities are also being provided for the operation and maintenance of heavier-than-air craft. For the storage of helium gas a large 2,000,000-cu.ft.-capacity, low-pressure gasometer is being provided, together with 750 lb. per sq.in. storage in small tanks to the extent of 2,000,000 cu.ft. additional. A helium repurification plant of 30,000 cu.ft. per hour capacity is an unusual feature. There are the other customary buildings and utilities required at such a station, including barracks, dispensary, power plant, shops, storehouse, administration building and officers' living quarters.

The hangar is 1,125 ft. long, 200 ft. high and 308 ft. wide externally. Although similar in shape to the airship hangar erected at Akron by the Goodyear-Zeppelin Corp., the Sunnyvale hangar includes in its design many new and unusual features.

The main frames of structural steel spaced 72 ft. apart are three-hinged arches, the lower hinges supported on A-frames 55 ft. above the floor line. The orange-peel-shaped doors at each end of the hangar fit closely to the main structure, when open, the ends of the latter being curved and warped to conform to the doors of this shape. Each end door consists of two leaves supported on standard-gage railroad wheel trucks with independent top-supporting vertical pins or hinges at the uppermost part of the hangar structure.

The main body of the hangar contains two transverse expansion joints so located that the ends of the hangar with the door pin mountings are fixed in position. The curved roof of the hangar and the upper part of the doors are sheathed with redwood. Where the slope is relatively flat, the roof covering is of built-up asbestos felt. The steeper portions of the roof and the side and door walls are covered with asbestos-protected metal.

Other buildings comprising the station are of modern design and construction, utilizing steel, concrete, tile and similar materials of permanence. The Spanish Mission style of architecture has been adopted. Since the site of the station is within the zone of influence of known earthquake faults, it was necessary in designing all of the buildings and structures to take into account the probability of stresses from such a cause. This possibility also was given careful attention in the selection of materials to be utilized. For this reason each two A-frames supporting an arch of the hangar are heavily tied together across the hangar by steel rods embedded in concrete below the hangar floor. During the progress of erection work on the hangar and continuing well after its completion, numerous special strain-gage measurements are being taken at the more critical points in the framing. These measurements, made under various conditions of loading from wind, position of doors and temperature, should be of value in determining the accuracy of the design assumptions and for guidance in future similar work.

Helium for the operation of airships and balloons is secured initially at a high percentage of purity, but after use it becomes contaminated by the atmosphere and requires purification. This operation will be performed in a special plant that operates on the principle of liquefying all impurities by a high-pressure, low-temperature refrigeration process.

Types of buildings

The bureau is called upon to provide buildings for various purposes. Many of these are shop buildings and barracks. Utility and economy are the controlling factors in the design, and endeavor is made to obtain pleasing effect by correct proportioning rather than by architectural ornamentation and elaborate treatment. The wide geographical distribution of this work necessitates knowledge of the differing climatic conditions, the interior layout best suited to the climate and local building materials available.

A building recently completed is the barracks at the Naval Air Station, Anacostia, D. C., which is a two-story

structure in colonial style and gives a suggestion of Mt. Vernon, only a few miles distant.

Graving docks

The concrete and granite graving drydocks at Bremerton, Wash., and Charleston, S. C., were recently extended to take large aircraft carriers and new light cruisers, respectively. Old timber drydocks at New York, Philadelphia and Puget Sound were reconstructed during the past year. Those at the first two yards were rebuilt in concrete above the mean low-water line, but below this line they adhere to the original Simpson design in timber. The one at Bremerton was relined entirely in concrete. The timber drydock at Norfolk is now in the process of reconstruction in a manner similar to that used at New York and Philadelphia. Drydock No. 2 at New York, a concrete structure, was provided with a new granite entrance and was otherwise rebuilt in concrete. That project required a cofferdam outside the sill in a treacherous foundation soil. The general character of the work has been of such a nature as to render the old and deteriorated graving docks modern and up-to-date, fully ready and capable of taking ships within the sizes of the docks. Every effort has been made, by following the best engineering practice such as proper proportioning of concrete, and by new methods, such as special waterproofing, to make the docks fit for many years' service without extensive future repairs.

A fitting-out crane of 250 gross tons capacity is now being erected on Pier 6 at the Navy Yard, Puget Sound, Wash. This crane is of the revolving hammerhead type and will be capable of lifting its rated load on two 125-ton hoists at a radius of 115 ft. An auxiliary hook load of 30 gross tons can be handled on a separate hoist at 180-ft. radius. The clear lift height of the main 250-ton hook is 106½ ft. above the deck of the pier; the 125-ton hooks have a clearance of 115 ft. above the deck. The crane is electrically operated throughout, using direct current at 230 volts. All hooks can be lowered 30 ft. below the level of the pier deck. The 250-ton Puget Sound crane is somewhat similar to the 350-ton crane erected at the Philadelphia Navy Yard during the war, but with a considerably changed design based upon Philadelphia experience and changed conditions.

Hawthorne ammunition depot

One of the most important steps in the program of improved facilities for the storage of ammunition and high explosives has been the establishment of the new ammunition depot at Hawthorne, Nev. By an executive order issued in 1928, there was withdrawn from public entry an area of about 125,000 acres at Hawthorne adjoining the southerly end of Walker Lake in Mineral County, Nev. In this area there has been developed a large-capacity ammunition depot embodying the latest knowledge as to the safe storage of explosives. The layout of the station places the personnel and industrial areas several miles away from the explosives storage area. The individual magazines are at such distance from each other as to remove all likelihood of sympathetic detonations. The groups of magazines are separated by such distance as practically to eliminate missile hazard. The layout of this plant is such as to minimize the possibility of total disablement by an explosion in any one building.

The depot has a gravity water supply from streams in two canyons. A still more recent ammunition depot, similar to that at Hawthorne, Nev., is under construction not far from the Naval Station, Pearl Harbor, Hawaiian Islands.

Work at Pearl Harbor

The bureau has just completed at the submarine base, Pearl Harbor, an unusual tank for the training of men in escaping from sunken submarines. This tank, which is 18 ft. in diameter and 120 ft. high, is surmounted by a loft containing a crane for handling a diving bell. A circular stairway on the outside connects the loft with the equipment house at the base. At heights of about 65 and 100 ft. the tank is equipped with air locks, and built into the base of the tank is a full-sized section of a submarine. The equipment house at the base is fully equipped with filtering, chlorinating and heating equipment for the water in the tank, a decompression chamber and medical equipment. An elevator was added recently to the equipment for the quick handling of emergency cases occurring in the normal operation of the tank. The tank is equipped with high- and low-pressure air lines, oxygen lines and special submarine lights and telephones. A similar tank has been built at the Submarine Base, New London, Conn.

A repair basin at Pearl Harbor, T.H., is being designed primarily for the repair of large ships. As proposed, the completed project will comprise a central pier 100 ft. wide by 1,100 ft. long, flanked on both sides by 325-ft.-wide slips having a minimum dredged depth of 40 ft. at mean low water. The other sides of the slips will be bounded by marginal quay walls for the greater portion of their lengths, which will extend shoreward from the original high-water line. The outer ends will be open-pier type. These piers will be of reinforced concrete supported on concrete cylinders, four to each bent, which are spaced 24 ft. on centers. The cylinders will be filled with concrete and supported below the dredged depths on wooden pile clusters. Quay walls are of similar construction except that one longitudinal row of cylinders is used along the front, the remaining areas being supported on precast concrete piles. A 200-ton crane, already available, of the hammerhead type with maximum capacity at a radius of 85 ft. and a lift of 118 ft. above its base, will be installed on one of the quays. Provision is being made for the future installation of traveling cranes of 15-ton and 50-ton capacity on the pier and quay walls. Electrical, compressed air, oil and water services will be provided at all berths. Appropriations are available for the first portion of the project, which includes 700 ft. of pier, quay walls and the installation of the 200-ton crane.

The new pier at the Naval Operating Base, Norfolk, Va., is another good example of the class of reinforced-concrete waterfront work of the bureau. This pier, designed especially for the mooring of the high-sided aircraft carriers "Lexington" and "Saratoga," is 1,354 ft. long and 104 ft. wide. The reinforced-concrete piles of the substructure are 18 in. square and vary in length up to 66 ft.

The bureau, as noted previously, has just been conducting thorough studies of soil conditions at the site of the New Naval Hospital in Philadelphia, Pa. These studies include, in addition to the usual core borings and driving and loading of wooden test piles, the obtaining of undisturbed samples of the clays underlying the site, analysis of these clays to determine their physical properties (including compressability) and calculation of the probable settlement of the various parts of the buildings due to the increased loads on these clays. These studies have greatly influenced the design of the foundations and the buildings themselves.

Careful observations will be made of settlement during construction and for a period of years to check calculated settlements against actual settlements.

* * *

CONSTRUCTION WORK is carried on by the Bureau of Yards and Dock at the ten navy yards, six naval stations, three operating bases, eleven air stations, and also at the ordnance stations, Marine Corps bases and barracks, hospitals, fuel depots, supply depots, torpedo stations, submarine bases, naval prisons, the Naval Academy, the War College, the Naval Observatory, the Experimental Laboratory and a large number of radio and direction-finder stations. In addition, at the navy yards and naval stations it handles the work of maintenance and repair and performs certain operating functions.

In the bureau at Washington there are 58 permanent and 43 temporary technical employees and 52 permanent and 5 temporary clerical employees. The temporary employees represent an increase required by recent emergency relief programs. In the field the number of employees at each locality varies with the amount of work at that place.

The present bureau organization is as follows: Rear-Admiral A. L. Parsons, chief of bureau; Captain G. A. McKay, assistant chief of bureau; Captain C. A. Carlson, head of war plans section; Captain W. H. Allen, design manager; Captain G. S. Burrell, project manager for ordnance establishments; Ltd.-Comdr. P. J. Searles, project manager for fleet, yard and base facilities; Lt.-Comdr. R. E. Thomas, project manager for aviation activities; S. W. Bates, project manager for power plant facilities; F. W. Southworth, project manager for hospitals and personnel buildings; E. C. Sherman, project manager for fuel and radio stations and Marine Corps activities; W. M. Smith, head of maintenance and operating division; E. H. May, head of contract division; and E. W. Whitehorne, chief clerk.

Trends in Highway Traffic in the New York Region

More motor vehicles constantly enter Manhattan as more facilities are provided—Present time can be profitably used for effective planning, in which account is taken of these new facilities

DECENTRALIZATION of the population of Manhattan Island in the last ten years, with a decided trend to the outskirts, was shown decisively by the 1930 census. Centralization of the daytime business activities in the center of the region has continued and is shown, so far as vehicular traffic is concerned, in a recent study and various traffic counts made by the Regional Plan Association of New York. Comparison is made of daily traffic into Manhattan in 1924 and 1932.

The concentration of motor vehicles upon the island of Manhattan, and particularly upon that part of Manhattan south of 59th St., has been increasing steadily during these eight years. The highway facilities serving this part of the region have been supplemented by the Holland Tunnel and George Washington Bridge across the Hudson River, additional roadways on the Manhattan and Queensboro bridges across the East River, the improvement of several of the avenues in Manhattan and the partial completion of an express highway along the Hudson River.

The following are some of the most striking figures brought out by the analysis: The number of vehicles entering southern Manhattan from New Jersey on a typical business day has increased 95.2 per cent, or more than four times as fast as those coming from north of 59th St. But the total number from the north in 1932 was five times that from New Jersey and represented 52.6 per cent of the total number entering southern Manhattan from all directions. A detail census of the southbound vehicles on each of the avenues crossing 59th Street showed 163,069 vehicles in 16 hours and an estimated 178,750 in 24 hours. The maximum hourly movement was between 9 and 10 a.m. and totaled 13,315 vehicles.

A total of 261,496 vehicles entered Manhattan on a typical business day in the spring of 1932. Due to the large movement within Manhattan the corresponding total entering southern Manhattan was 284,398 vehicles. The former represented an 83.3 per cent increase over 1924 and the latter a 46.6 per cent increase, which would indicate that the flow of traffic is spread more evenly over Manhattan than formerly.

The Holland Tunnel is carrying far more traffic than was originally estimated, even with the 8.8 per cent loss over 1931 indicated by the figures for the year ending Nov. 13, 1932.

In 1931 there were 1,865,109 motor vehicles registered in the region, giving a ratio of 6.3 persons per motor vehicle. Only 43 per cent of these vehicles were registered in New York City, which had 60 per cent of the total population.

With the aid of men from the Architects Emergency Committee and the Emergency Work Bureau, the Regional Plan staff made a 16-hour count of southbound vehicles crossing 59th St., Manhattan, on typical business days in June, 1932. This count formed the basis for estimating the total number crossing 59th St. in a whole day of 24 hours and, combined with counts available from other sources, made possible the computation of all vehicles entering Manhattan below 59th St.

Deducting from the traffic crossing 59th St. those from the upper deck of the Queensboro Bridge and the estimated number turning south on its lower deck (which have been charged to traffic from Long Island), the number of vehicles entering southern Manhattan from the north has increased about 22.8 per cent over that of 1924. Of the total entering the area below 59th St. the proportion from the north has decreased, however, from 62.8 per cent in 1924 to 52.6 per cent in 1932.

Striking changes have taken place in the distribution on the avenues. Three entirely new facilities have been made available for the traffic crossing 59th St.; the West Side elevated highway, a connection with the Central Park roadways at Sixth Ave. and a connection with the new upper deck of the Queensboro Bridge. Of the remainder of the crossings some have greater traffic, three show less traffic, and some carry virtually the same.

Eleventh Ave. carries nearly four times the traffic it had in 1922. Substantial improvements of the avenue and the opening of the Holland Tunnel appear to be the reasons for most of this increase. With the completion of the West Side elevated highway, it is probable that the greater part of its present load will be shifted to that facility, leaving for the most part local traffic and that portion of long-distance traffic with origin and destination along the West Side of Manhattan.

Ninth Ave. and Tenth Ave. show very slight increases over the earlier count, with Ninth Ave. carrying only about half the amount of Tenth Ave. Their normal increases have obviously been shifted to Eleventh Ave. and the West Side elevated highway.

Traffic entering Columbus Circle from the north has been grouped together, including vehicles on Broadway, Central Park West and from the roads of Central Park. A marked decline in volume from these sources is due in part to the new provisions for southbound traffic in the Park. As stated above, a connection has been opened to Sixth Ave. The westerly roadway in the park has been restricted to southbound traffic, with the easterly roadway carrying only northbound traffic.

Fifth Ave. shows a loss in traffic, as the 1922 figures included southbound vehicles from Central Park, now diverted to Sixth Ave. Madison Ave. shows a slight increase, with a volume still less than half the amount that Fifth Ave. carries. Park Ave. is far in the lead of all the others with a volume nearly double its 1922 load as a result

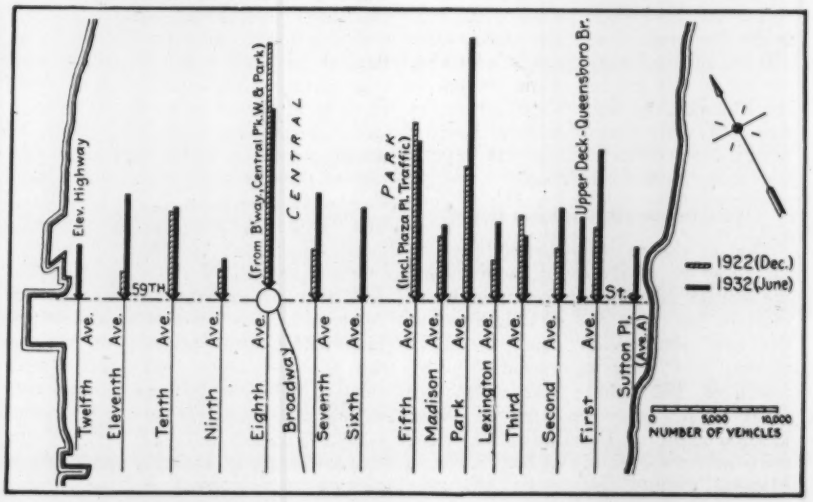


Fig. 1—Southbound vehicular traffic crossing 59th St. in a 12-hour period from 7 a.m. to 7 p.m. on a typical business day in June, 1932, compared with a day in December, ten years earlier.

of widened roadways and the opening of the new roadway on the east side of Grand Central Terminal. Lexington and Second Aves. have nearly doubled in volume, absorbing between them the decrease shown on Third Ave. First Ave. has about doubled its load, due to improvements of the roadway. Sutton Place has increased in volume many times, due also to roadway improvement.

The greatest number at any point in twelve hours was on Park Ave., as stated above, with 20,578, replacing Fifth Ave., which carried the most in 1922. The greatest number of vehicles passing any one point in one hour was on Park Ave. between 9 and 10 a.m., a total of 2,488 vehicles, or more than 41 vehicles per minute.

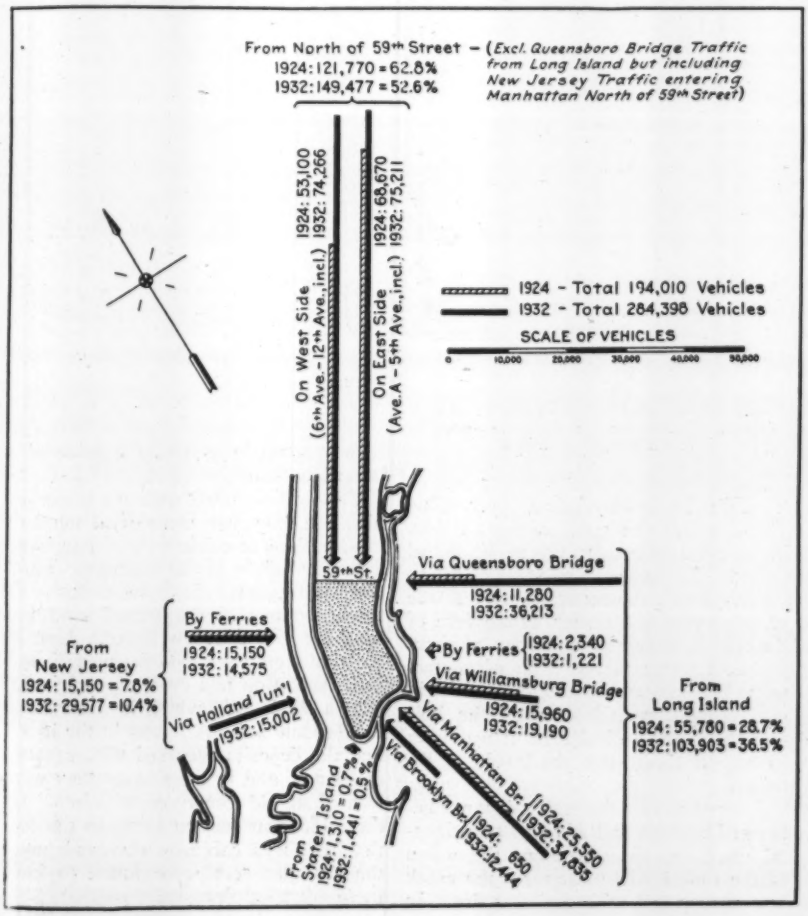
The completion of the West Side elevated highway to 72d St. will probably affect the distribution of traffic on most all the avenues. The Regional Plan highway proposals for Manhattan are designed to divert a large proportion of the through north and south traffic to the sides of the island, leaving the avenues in the central business districts more nearly free for local circulation.

The largest rate of growth in vehicular traffic entering Manhattan during the eight years from 1924 to 1932 was across the Hudson River. Here the number of vehicles increased 107.5 per cent, as compared with an increase of 92.0 per cent across the East River. Each of these large increases has occurred in spite of the fact that motor-vehicle registration has grown somewhat slower than was estimated.

The staff of the Regional Plan in 1927 made a special study of the movement of motor vehicles between Manhattan and New Jersey. On the basis of future population estimates and the vehicular movement which would result between different sections of the region, estimates were prepared of the traffic movement that might be expected across the Hudson River in 1965. From such figures estimated trends for the years 1926 to 1965 were prepared.

These estimates were made before the Holland Tunnel was opened and were based on the increased traffic which might be expected from that tunnel and from the completion of the George Washington Bridge, which was then under construction. No attempt has been made to revise the early estimates, which are considerably below the present-day traffic but which, it is believed, still present a conservative estimate for 1950. In fact, the total estimated traffic of 45,000,000 vehicles in 1950 between New Jersey and Manhattan might well be considered as the minimum that may be expected, with every likelihood that it will be exceeded.

Fig. 2—Vehicles entering Manhattan south of 59th St. during a typical day in 1932 compared with 1924.



The Holland Tunnel traffic in 1931 was 12,756,193 vehicles, or almost twice the minimum figure as estimated by the Regional Plan four years earlier. The new traffic created by this facility has shoved the curves of actual traffic well above the estimated curves, both for the total between Manhattan and New Jersey and for those crossing the Hudson River south of 40th St., Manhattan. While the 1932 total is not yet available, the total for the year ending Nov. 13, 1932, was 11,636,446 vehicles and gives a close approximation to the probable figure for the calendar year. This would be an 8.8 per cent loss over 1931 and shows a downward trend that is undoubtedly only temporary. It is of interest to note that the break in this curve followed two years after those in the motor-vehicle registration curves. Estimate made in 1927 for the minimum traffic over the George Washington Bridge was 6,100,000 vehicles for 1932, which is fairly close to the traffic actually carried by the bridge during its first year of operation, ending Oct. 15, 1932, when it had carried 5,628,234 vehicles. Judging from the Holland Tunnel curve, this was less than it would have carried under normal conditions.

It was stated by the Regional Plan Association in connection with the early estimates that they indicated that "at least one additional bridge or tunnel connection will soon be required and that such a structure should connect with southern Manhattan near the uptown business district." As the number of vehicles crossing the Hudson River south of 40th St. in 1931 has already equalled the estimate for 1943, this statement is proved true today, even though the projected 38th St. tunnel should take away sufficient traffic from the Holland Tunnel to bring its total nearer the estimated minimum.

The engineers of the Regional Plan Association make the following observations: With the pressure for the rapid supply of new highway facilities during the past ten years there has been a rush to construct such facilities at those points where the demand for relief was greatest. There was little time to relate such projects to a comprehensive plan, and yet the new facilities do in most cases fit in admirably with the proposed regional highway system as it appears on the Geographic Regional Plan. Official agencies responsible for the planning of new highways, bridges and tunnels have an opportunity now to catch their breath and to plan more comprehensively for the future. To this extent the present lull in construction activity is an advantage. It should be used for planning a renewed expansion of highway facilities along the most practical lines.

Concrete Water Tunnel Inspected After 25 Years

Blue Island Ave. tunnel in Chicago is found structurally sound and practically uneroded but exhibits internal accretions of calcium carbonate in circular ridges at construction joints and as large obstructions at points of seepage

WHEN the Blue Island Ave. tunnel of the Chicago water system was unwatered last year to permit making a connection to a new cross-connecting tunnel, an opportunity was provided to make a thorough inspection of a concrete water tunnel that had been in service for a quarter of a century. For the most part the tunnel was found to be structurally sound, but it was discovered that conditions had developed in those years that had materially increased the resistance to flow. Great numbers of internal accretions of calcium carbonate were in evidence, many of them of surprising size. Most of them were located at old construction joints. The concrete behind these accretions showed some weaknesses when subjected to physical and chemical tests but not enough to cause alarm.

Most remarkable of all, a timber pile was found driven through the tunnel roof, reaching to within 18 in. of the floor. Leakage into the tunnel was comparatively slight, and there was no evidence of any leakage that might constitute a health hazard. Débris of various kinds was found, including timbers, logs, a coil of wire and an old ladder.

The Blue Island Ave. pressure tunnel, 8 ft. in diameter, was built in 1907 and 1908 to replace an old 7-ft. cross-town tunnel built in 1875 to connect the 22d St. and Chicago Ave. pumping stations. It is circular in cross-section and is lined with 10 in. of 1:3:6 concrete and finished with a ½-in. coat of cement plaster. Its total length is 29,237 ft. The driving was through soft blue clay all the way, with the exception of one 750-ft. section near the south end where rock was encountered. All clay headings were driven under air pressure of about 10 lb. Steel forms and lagging were used in 6-ft. lengths. No reinforcing was used except in a 400-ft. section under the north branch of the Chicago River. The tunnel was built under contract by George W. Jackson, Inc., and under the general supervision of the late John Ericson, city engineer.

The most remarkable discovery in the inspection of the tunnel was that of a timber pile driven through the roof. It had probably been driven in 1919, when an addition was made to the Baltimore & Ohio Railroad viaduct over Blue Island Ave. The pile, having an 8-in. tip, did no serious damage to the tunnel lining. It made a reasonably sharp shear through the concrete, with a hole of about 18-in. diameter at the face of the tunnel, which tapered back to about 10-in. diameter at the point of contact with the masonry. The pile was in good condition and so filled the hole that there was no leakage. It was later sawed off flush with the inside of the tunnel.

For practically the entire distance between Harrison and 22d Sts. a horizontal crack was observed along the crown of the tunnel. In most cases the crack was not opened wide and was dry. In general, the tunnel was found to be in good structural condition, with leakage not serious in amount.

At one section a leakage of light tar oil was found. The estimated flow was from two to four drops per hour, and the material had a viscosity of 80 (A.S.T.M. scale). A 4-in. hole was punched through the concrete in an attempt to increase the flow, but the leakage continued at the same rate. A bar punched through the hole into the overlaying clay failed to produce any tar. Investigation failed to locate the origin of the material, although it apparently came from outside the lining.

It was in this section that infiltration of water was most in evidence. At one point near the Chicago Ave. pumping station and at another just north of Washburne St. considerable leakage was discovered through the sides and top. There were numerous other places where water was found leaking through the concrete in small amounts, but not of such magnitude as to be considered a hazard to health.

Closely associated with the minor infiltration, however, were great numbers of accretions of calcium carbonate found adhering lightly to the concrete. There were thousands of these deposits in those sections of the tunnel west and south of the Chicago River. East of the river few such deposits were found. Each accretion had evidently originated with a small leak, which in many cases had become sealed. It was in the invert that the deposits occurred with greatest frequency, and in most cases they were located at old construction joints. Of the 1,153 construction joints in the section that was carefully surveyed, more than 90 per cent were found to have these adhering deposits.

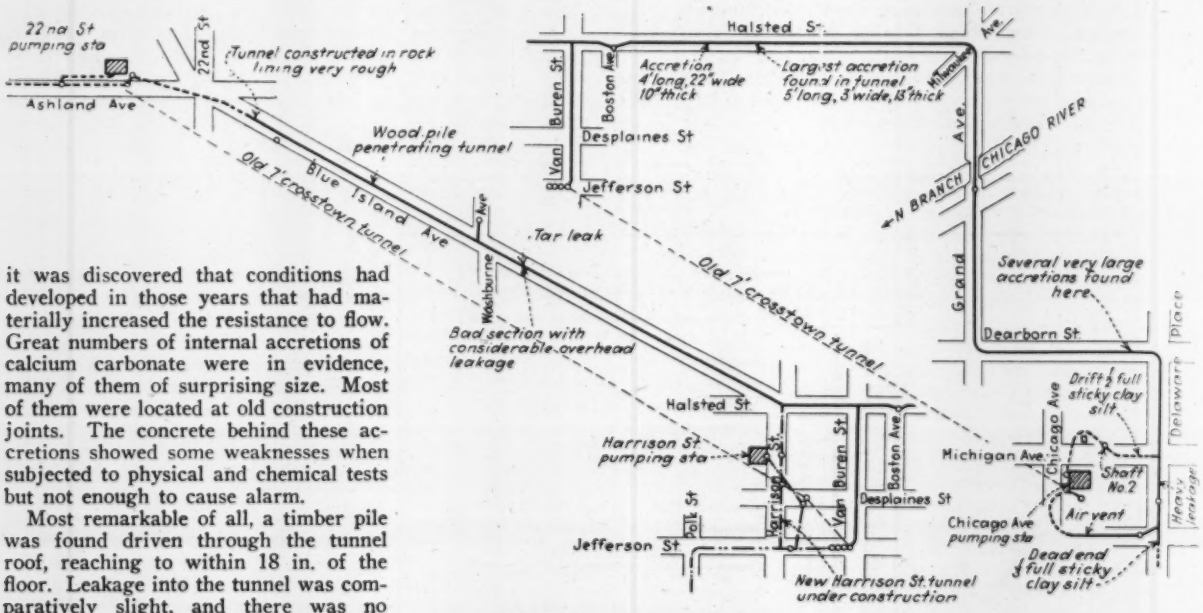


Fig. 1—Blue Island Ave. tunnel, Chicago, which was inspected after a quarter century of uninterrupted service.

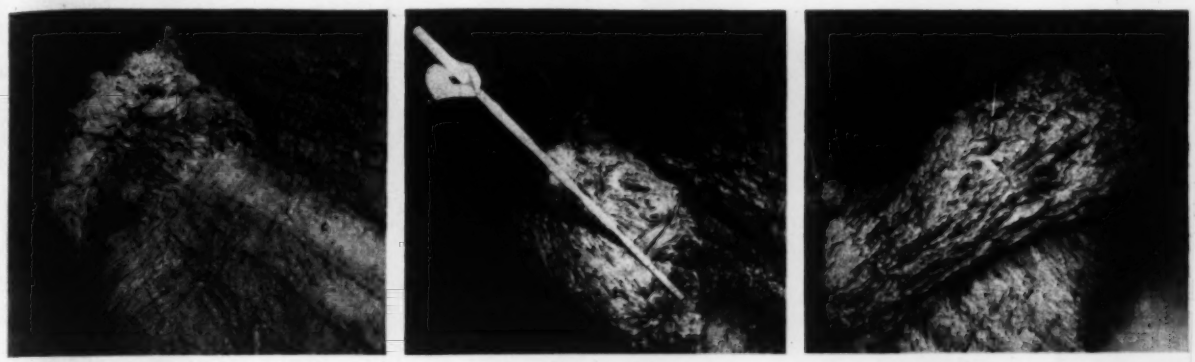


Fig. 2—Calcium carbonate accretions, starting from construction joints, extend downstream several feet and from 10 to 13 in. into tunnel.

Some of these accretions were of remarkable size. The largest found was 5 ft. long, 3 ft. wide and 13 in. thick. Those at the construction joints protruded from the face of the tunnel lining ½ in. or less in about half the number of cases, while 10 per cent protruded about 2 in. Their thicknesses ranged from about ½ in. to more than 8 in. In that part of the tunnel south of Harrison St. 851 individual accretions were located, in addition to the small ones at construction joints that ranged in area from 1 to 6 or 8 sq.ft., and in thickness from 4 to 8 in. All the deposits were soft and were easily broken off by the workmen's feet.

It was noted at a curved section of the tunnel that there were no accretions on the outside of the curve where the velocity of flow has been high, while they were plentiful on the opposite wall. The velocity at no point in this region, however, had been great enough to erode the brush marks in the cement plaster, indicating that a velocity sufficient to prevent the formation of the carbonate accretions would not be great enough to wear the lining materially. This observation suggested that there were worth-while economic savings possible by increasing the velocity of flow, providing greater capacity through the tunnel and at the same time preventing the formation of the accretions.

Several inferences were drawn from the observations made of the numerous deposits. First, the accretions were formed by salts dissolved out of the concrete by groundwater seeping into the tunnel through leaks either in the tunnel walls or at construction joints. Second, the concrete undoubtedly has been weakened by this action. Third, the growth of these deposits has been accompanied by gradually increasing friction loss through the tunnel.

The shape of the accretions seemed to depend largely on the direction of the flow of water in the tunnel. They came almost to a point at the point of infiltration and spread out fanwise in the direction of flow, getting wider and thicker in that direction. In several places, such as leads to shafts where there was no flow of water, the accretions branched out in various directions, somewhat like the roots of a tree.

A number of the accretions, together with samples of the tunnel concrete, were taken to the laboratory and there subjected to physical and chemical tests. In reporting on the laboratory findings, John R. Baylis, chemist of the water-purification division, noted that they were very porous and when broken open would release a small amount of water. This water was found to contain about 450 p.p.m. of calcium hydroxide, indicating a 30 percent saturation at the temperature of the water flowing through the tunnel.

Examination of the samples, according to Mr. Baylis, showed that the concrete is of poor quality and that there is evidence that it has deteriorated to a considerable extent. A sample picked up from the floor where the pile had been driven through was pulverized and placed in a flask of distilled water. The low value of the caustic alkalinity of the water after several hours showed that practically none of the high-calcium cement compounds were present. An alkalinity test on a sample cut from the straight section of the tunnel showed that the concrete there was in better condition. It was observed, however, in crushing this sample that parts of it appeared to be in good condition and fairly hard, while other parts were weak.

Fig. 3—Numerous individual accretions were found in lower half of tunnel ring between joints. The upper half of the tunnel was clear.

"A mixture of 1:3:6 concrete naturally contains a large number of small voids," said Mr. Baylis in his report.

Fig. 4—Offset in tunnel at Harrison St. Note the white accretions at joints. The near joint at the right and the far joint at the left are both in eddy current zones. The near joint at the left (between cuts for specimens) is in a high velocity zone. Bricks are for bulkhead work.

"It was found upon examination with the microscope that these voids in certain places were almost entirely filled with needle crystals of calcium sulphoaluminate. Apparently what took place is that the sulphate originally added to the cement to retard initial setting has undergone a change in composition. It is not known exactly how the sulphates occur in the cement when it first sets; and while it is thought to be some form of calcium, aluminum and sulphates, the needle crystals are not observed in freshly made cement. . . . It was noticed in the pieces of concrete that were cut from the wall of the straight section of the tunnel that where the needle crystals were most abundant the concrete appeared to be weakest. There was no difficulty in breaking the concrete to pieces with a small screwdriver at such places, whereas in other sections in which the needle crystals were not so abundant the concrete appeared to be harder.

"It is believed that the strength of the concrete has been reduced quite materially from its original strength. The tests for calcium hydroxide, when water is placed in contact with the pulverized concrete, show that there may be a little of the concrete containing its original high-calcium compounds, but that most of the concrete compounds have been changed. The fact that there are no breaks in the tunnel indicates that it is of sufficient strength for the load it now has to carry."

At points where there was little or no flow great quantities of silt were found, at one place to a depth of 4 ft. An unused drift south into Michigan Ave. was found half filled with mud. Several old planks were found where an air lock or narrow bulkhead had been placed during construction. Other construction debris was found in the tunnel, including two coils of insulated wire, a number of pieces of wood with double glass insulators attached, an 8x12-in. water-logged timber 10 ft. long, a wooden ladder and other timbers that had apparently floated in from the intake cribs.

Before putting the tunnel back into service the timbers and other debris were removed, the carbonate accretions were cleaned off, and the timber pile was cut off flush with the concrete face.

Personnel

The inspection was carried out under the general direction of Myron B. Reynolds, city engineer, by the water-purification division in cooperation with the construction division. The personnel of the various parties included the following: Mr. Reynolds; A. E. Gorman, engineer of filtration; John R. Baylis, chemist; H. H. Gerstein, sanitary engineer; R. O. Waller and T. F. Donahue, assistant sanitary engineers of the water-purification division; William Weldon, division of water-pipe extension; Milton Shuhan, H. R. Matthei and N. Z. Konstant, design division; and J. J. Versluis, engineer of waterworks construction.

Difficult Sewer Tunnel Built by Welfare Labor

Emergency form of cost-plus-fixed-fee contract used because of civil service restrictions on force-account work

By William P. Morse
City Engineer, Newton, Mass.

A SEWERAGE project estimated to cost $350,000 is going forward under an emergency form of cost-plus-fee contract in Newton, Mass., for the two-fold purpose of relieving a badly overloaded portion of the city's sewerage system and of providing work for the able-bodied workers of the city, who, unemployed, were dependent for their support upon the welfare department of the city.

A high-level intercepting sewer, 60 and 63 in. in diameter, is being built to divert the sewage from the high land to an extension of the high-level sewer of the Metropolitan District Commission (serving Boston and other cities and towns), thus relieving the lower portion of the system. The estimated cost of the project was much higher than had been expected by the city authorities, but with many men out of work and receiving help from the welfare department and the mayor's relief committee, the mayor and board of aldermen did not hesitate to proceed with the work.

Fig. 1—Liner plates are used where the tunnel runs through soft unstable rock.

In view of the difficulties of requiring the contractor to use welfare labor under the usual type of municipal contract, consideration was given to a form of contract that would assure the use of such labor. The civil service restrictions are such that construction by welfare men on force account did not appear feasible.

Cost-plus-fixed-fee contract

A modified form of cost-plus-fixed-fee contract was executed with T. Stuart & Son Co., a local contracting company and one of broad experience and high standing. Such a type of contract assures the use of local and welfare labor, and it also provides the experience and driving energy of a successful contractor.

It calls for the city to pay for all labor, materials, supplies, small tools, for all trucking at stated hourly rates, with ample restrictions regarding delays and for drill and tool sharpening at 15 and 10c. each, respectively.

There is a fixed payment of $30,000 for plant rental. This fee was agreed upon after investigations had determined what equipment would be required and at what prices such equipment could currently be hired. The only other payment to the contractor is a fee of $1 for profit and overhead. As most of the plant is owned by the contractor, was idle and might continue so, the plant rental may be considered as including some compensation for his overhead and use of capital.

The resident engineer authorizes the placing of orders for materials and supplies after the contractor has ob-

tained quotations; he certifies as to the delivery of the full order and approves the receipted bill after it has been paid by the contractor. Advantage is taken of competitive prices and cash discounts on all purchases. The resident engineer also certifies to the accuracy of all payrolls, the character of work done by the several men and the amounts paid them. The contractor pays all bills and payrolls and is reimbursed by the city, monthly for materials and supplies and weekly for labor.

At a conference with the heads of the city welfare department, the soldiers' relief committee and the mayor's relief committee, the qualifications for the different types of labor were defined by

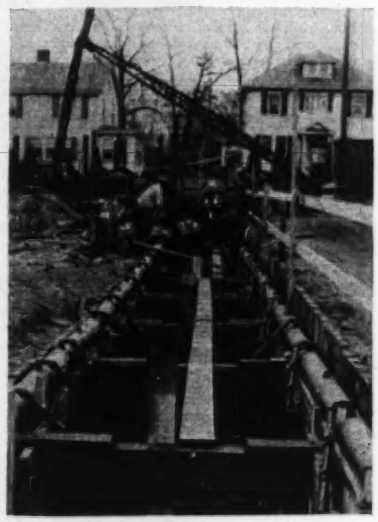


Fig. 2—Part of the sewer line is built in open trench. Well points are used to depress the groundwater level where there is wet running sand at the bottom of the trench.

the contractor, that is for pick-and-shovel men, for carpenters, etc. The contractor notifies the mayor's relief committee of the number of each type of men required from time to time. The welfare department and the soldiers' relief committee pick out men on their lists with these qualifications and certify them to the relief committee. The head of this committee sends the men with a card to the contractor on the job. The contractor puts them to work after verifying their physical fitness and capability. He deals only with the head of the relief committee.

When men first report for work and look the job over, a few of them decide they do not care for it and walk away. Such men thereby forfeit their good standing with the relief and welfare organization. For the most part, however, the men appear to have been well qualified, willing to work, and the success of this method of handling labor seems to be assured. Most of the common welfare labor receives full-time employment at 40c. per hour, or $19.20 per week. Most of the welfare carpenters work three days a week at 75c. per hour, although a few leading carpenters work full time at the same rate.

DISTRIBUTION OF LABOR FOR WEEK OF FEB. 4, 1933

	Men		Payroll	
	No.	Per Cent	$	Per Cent
Exempt from Newton residence by virtue of experience	91	34.8	$2,907.19	44.6
Newton residents	170	65.2	3,605.15	55.4
Total	261	100.0	$6,512.34	100.0

DISTRIBUTION AFTER ELIMINATING EXEMPTED MEN

	Men		Payroll	
	No.	Per Cent	$	Per Cent
Welfare men	116	68.2	$2,268.22	62.9
Other residents	54	31.8	1,336.93	37.1
Total	170	100.0	$3,605.15	100.0

Preliminary borings indicate that the tunnels will be largely in rock that is a laminated slate. In the Mount Ida tunnel, which is 150 ft. deep at the maximum, the borings indicate so little rock over the roof of the tunnel that undoubtedly in some parts the rock will run out and the tunnel will be in earth.

Experienced men hired from outside

It is realized that work in rock tunnel and winter work in open cut, partly in fine wet sand requiring the use of well points and partly in rock, is not ideal for the employment of welfare labor. The results nevertheless are gratifying. Since Newton is largely a suburban residential community, skilled labor of certain types was not available among its citizens. Hoisting engineers, shovel runners, drill runners, pump operators and tunnel foremen in each of the four headings had to be secured from out of town. Some other key men such as experienced and hardened tunnel muckers also came from out of town. The contractor is permitted to employ these men from whatever source he can obtain them at prices not to exceed those stipulated in his contract.

At this writing the work has been going on about a month and a half, and distribution of labor is as given in the accompanying table. Labor designated as "other residents" is not on the welfare list. It is probable that much of this labor would soon be on the list if this work were not provided. The proportion of welfare men is constantly rising as they become hardened, as they gain in experience and as more competent men are found to take the places of other labor.

It is believed that the efficiency of the welfare men is now at least 80 per cent as high as that of the non-welfare men, and that as they become more used to the work it will be difficult to see any difference in efficiency. This moderate inefficiency is more than offset by the reduction in expenditures of the welfare department equal to the wages paid the welfare men plus the wage paid those "other residents" who would have been thrown onto the welfare department had they not received this work.

Rapid progress being made

Progress in the four tunnel headings has averaged 6 ft. per shift per heading for each of the two shifts. This means a total of nearly 50 ft. per day. The 4,600 ft. of tunnel was 19 per cent holed out on Feb. 11. In open cut there have been only two lost days due to bad weather. Excavation and concreting have averaged about 50 ft. The 5,700 ft. of open cut was 10 per cent completed on Feb. 11.

The work is being financed by a 40-year serial-bond issue. Competition for the bonds was keen. Bids from thirteen bankers or groups of bankers were received on Dec. 9, 1932. The coupon rate is 3½%. The low bid upon which the loan was awarded was 102.76, making the cost of the money to the city 3.26%.

The most appealing arguments for proceeding with municipal construction work in these distressing times are those of obtaining works of permanent value for the unescapable expenditure for welfare, and of avoiding the morale-destroying dole. It is true that additional funds have to be provided for equipment, material and certain classes of labor that cannot be found on the welfare lists. It is important that strict accountability be enforced and that the work be handled in a businesslike manner.

This work was inaugurated by Mayor Sinclair Weeks and authorized by the board of aldermen. Construction is being carried out under direction of George E. Stuart, street commissioner, and the writer, as city engineer. Plans, specifications and the contract were prepared by Metcalf & Eddy, consulting engineers, of Boston, who are also furnishing resident supervision of construction.

New High-Strength Steel

Production of a new and improved quality of structural steel known as "Chromador" steel has been begun by Dorman Long & Company, Ltd., London, England. The steel has a guaranteed ultimate strength of 37 to 43 tons per sq.in. and a yield point of at least 23 tons. Chemical composition is as follows: carbon not exceeding 0.3 per cent, manganese 0.7 to 1.0, chromium 0.7 to 1.1, copper 0.25 to 0.5, silicon not exceeding 0.2, sulphur not exceeding 0.5, phosphorus not exceeding 0.05. As compared with the German St.-52 steel, first produced a few years ago, the British steel has a higher chromium and a lower copper content. The German steel is said to have a tensile strength of 39 tons per sq.in. and a yield point of about 22 tons. Chromador steel is the result of some ten years of research that began with the production by Dorman Long of the high-tensile silicon steel for the Sydney Harbor Bridge. It was the aim of the research to produce a steel as satisfactory as the silicon steel but less costly, and it is the belief of the manufacturers that this aim has been achieved. A rivet steel of similar properties to "Chromador" has also been developed. The price of Chromador is about 20 per cent in excess of that of mild steel.

Building Damage Sustained in California Earthquake

Long Beach earthquake did no damage to the structural frames of major buildings—Many deaths caused by falling debris, but few structures collapsed—Failure of brick masonry outstanding—Minor damage to residences and public works

EXAMINATION of the damage to Long Beach, where the earthquake that shook southern California about 6 p.m., March 10, was most severe, shows all major structural-frame buildings undamaged as to their essential structural elements. This fact confirms previous beliefs that buildings constructed in conformity with correct engineering principles are inherently resistant to earthquake movements of moderate intensity. At the same time it was equally well demonstrated that small building construction is not sufficiently controlled by code restriction and that brick fronts and parapets on stores and small apartments constitute a glaring weakness and potential deathtraps for people rushing out of buildings onto sidewalks. The illustrations published in our first report last week emphasize the inadequacy of these elements. There were no large structural-frame buildings in Compton, and in consequence the complete wreck of the smaller structures was more strikingly obvious. In Los Angeles, which was in a zone of less intensity, damage was restricted to old structures and to the breaking of windows, partitions and terra cotta facing.

The total damage caused by the earthquake will exceed $50,000,000, according to best available estimates. Yet it was of but moderate intensity as earthquakes go, and in general was not severe enough to justify far-reaching conclusions as to the relative merits of the various features of structural-frame design. Questions as to rigidity, flexibility and the comparative weakness of structural elements were not settled. It did show that lessons demonstrated in previous shocks have not been appreciated in regard to restrictions that should be imposed on ordinary construction practice for small buildings.

The loss of 120 lives can be almost entirely attributed to falling walls, cornices and debris from architectural treatments. It was particularly fortunate that the shock did not occur about three hours earlier in the day when the schools would have been in regular session. The collapsed condition of a score of school buildings indicate that, in such a case, the loss of life would have been appalling, probably reaching well into the thousands. As it was, the shock occurring when streets were full and stores and buildings emptying resulted in greater loss of life than if it had come later in the evening.

Fig. 2—Villa Riviera, a steel-frame, concrete-wall, 16-story apartment building, sustained a few broken windows and some interior partition and plaster cracks.

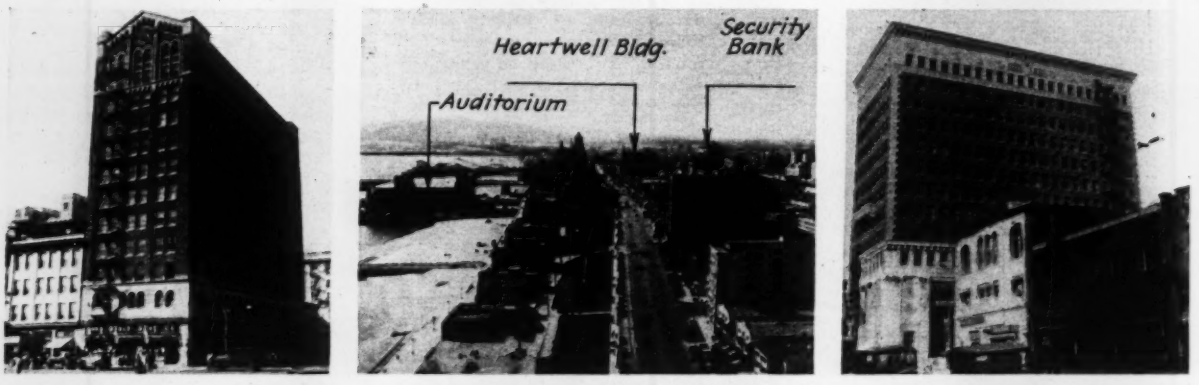


Fig. 1—The Long Beach skyline (center) was unchanged after the earthquake. As examples of structural-frame buildings, the Heartwell Building at left (reinforced concrete, 12 stories high), sustained only a few interior partition cracks and no broken windows. The Security First National Bank Building at right (structural steel, 12 stories), had only partition cracks and some cracked terra cotta facing. Both buildings were inspected and re-occupied at once. No damage was sustained by the auditorium built on filled ground in the bay, although the entire fill sunk 10 in. The building is on piles.

Seismic evidence

Estimates of the maximum acceleration of the earth movement vary, but do not exceed 0.1 gravity. Earthquake observers say that the intensity of the movement was equal to or less than that of the 1925 Santa Barbara earthquake. This conclusion is based on the evidence pointing to less effect on structural frames together with the fact that the concrete in the present case was of better grade than the poor class of material at Santa Barbara. Of course, the shock was in no way to be compared in intensity or extent to those at San Francisco in 1906 or in Tokyo in 1923.

The affected area extends about 15 miles north and south (Long Beach to Los Angeles) and about 20 miles east and west (Long Beach to Santa Ana). In spite of isolated cases of serious damage in outlying districts, it is reasonable to select the Long Beach, Compton, Watts line as the center of the disturbance, with the effect extending north into the Los Angeles area and southeast to Santa Ana. General observation shows that the major movement in Long Beach was north and south, while in Compton it was east and west.

Damage sustained by buildings

Detailed information and analysis of structural damage and the ability of various types of building construction to resist the seismic force must await the surveys now under way. In addition to the investigations being conducted by the building and school departments, the Los Angeles section of the American Society of Civil Engineers has appointed a committee to report on the

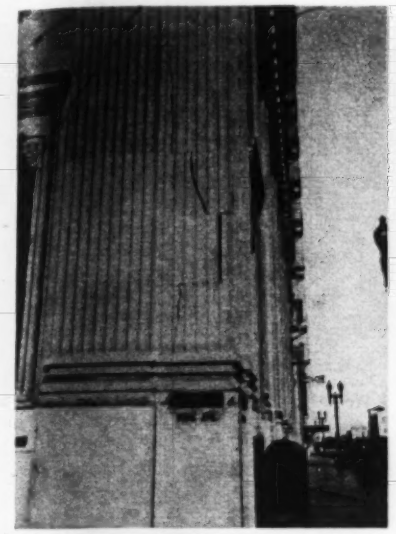


Fig. 3—Typical damage to structural-frame buildings consisted of cracked terra cotta facing near the ground (left) and interior cracking and occasional displacement of tile partitions (right).

Fig. 4—Racking in the concrete frame of this apartment took off the plaster exterior and cracked the tile filler wall, although not apparently injuring the frame.

matter. This committee is headed by Prof. R. R. Martel, California Institute of Technology, a recognized authority on seismic forces and their relation to structural design. However, an inspection of the buildings in the most intensively affected area immediately after the earthquake and the preliminary reports of surveys of safety indicate the following general conclusions:

Structural-Frame Buildings—As a full-scale experiment in the resistance of structural frames to a seismic force, the present disturbance stopped short of producing any definite evidence. Frames apparently were not stressed over their elastic limit, and although they were shaken and distorted enough to loosen and break some of the more brittle elements, such as panels of glass, plaster or tile in partitions and terra cotta facing (Fig. 3), the elasticity of structural members and of their connections was sufficient to maintain their unity unimpared.

Until a more detailed examination has been made this conclusion applies equally to frames of steel and reinforced concrete (Fig. 1). Further, there was no proof of any particular advantage of the so-called rigid frame design over flexible design. Although there was no building that could be classed as having definitely a flexible frame, there is a rather marked difference in lower-story rigidity between such a building as the Villa Riviera (Fig. 2), with its steel frame, concrete walls and small windows on the ground floor, and the Security Bank Building, also steel frame with long first-story columns and large windows (Fig. 1), in which the columns had relatively slight rigidity through two stories. The fact is that both of these structures came through without even serious partition cracking or window breaking.

In one minor feature of structural framing there were failures that call attention to a special design problem. Stair framing in several cases was broken away from connecting members. An explanation may be based on the fact that the diagonal framing of the stairway, whether it was a single diagonal without landing or in the form of a K-brace with a landing, was so much stiffer than the column-and-girder framework of the building as to tear away the stair framing first, after which the bent could deform normally.

A noticeable feature of reinforced-concrete frame action in the earthquake was evidence of movement along the pour joints at each floor level. This was particularly plain on those buildings that have a plaster coat. Often a defi-

Fig. 5—With brick walls down and timber roof intact, this structure typifies the damage sustained by this type of design. Failure of ties between brick walls and joists or rafters was a notable factor in these brick-wall failures.

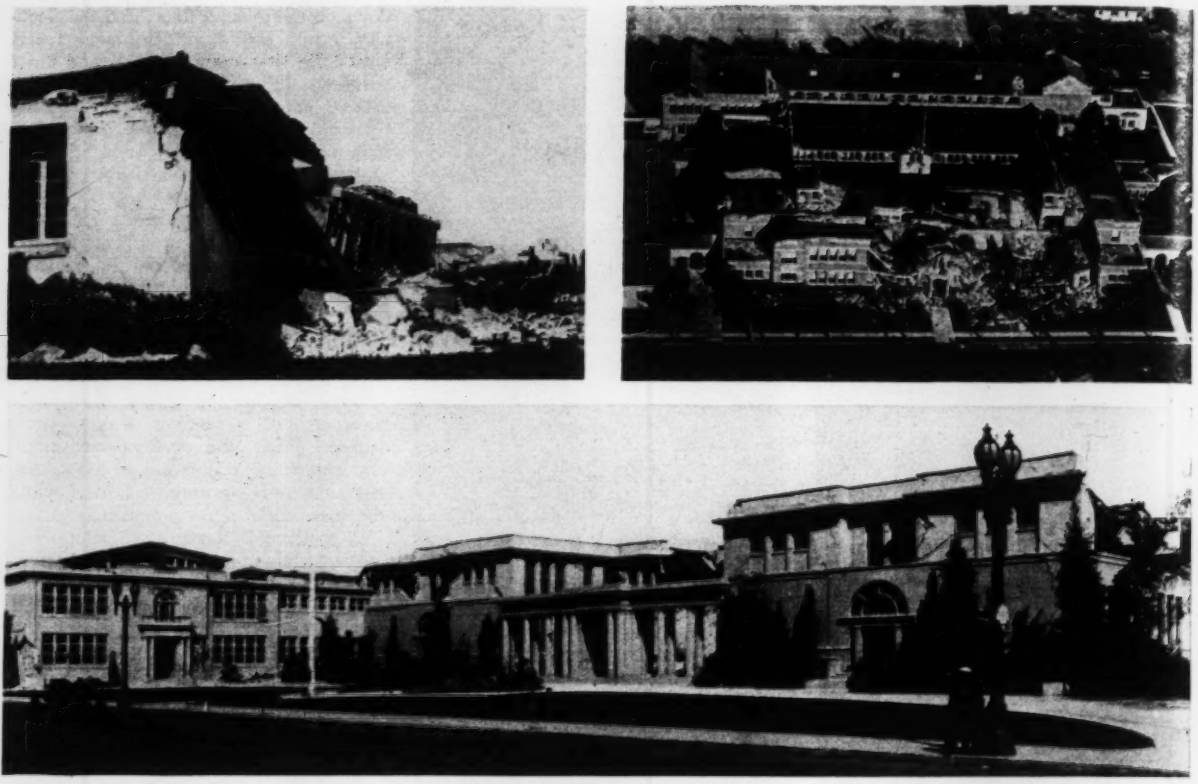


Fig. 6—School buildings, being mostly of masonry wall and timber-floor construction, suffered extensively. Above, at left, a collapsed public school building in Compton. A large high school building with structural frame adjacent to this school suffered comparatively slight damage. Above, at right, a Long Beach school, wrecked almost beyond repair. Below is a view of Polytechnic High School, the largest school building in Long Beach, which suffered extensive damage and may have to be rebuilt. A large dome in the center of the building collapsed and wrecked this portion completely. The side wings are badly cracked, and many pieces of brick wall were shaken down.

nite line of plaster cracks appeared for several stories above the ground along the line of the floors where successive pours were stopped. Lack of bond apparently produced a plane of weakness, so that there was a slight working along these joints.

Flexing of the structural frames was not sufficient to warrant any definite conclusions as to the relative merits of filler-wall construction. In one case, however (Fig. 4), there was pronounced failure of a hollow-tile filler wall in a five-story apartment building with a reinforced-concrete frame. No cases were observed where brick-filler walls had failed enough through flexing of the frame to produce characteristic X cracks in the panels, although there were several cases where the brick-filler wall panels showed evidence of slight movement along the lines next to columns and beam soffits.

From the viewpoint of better earthquake-resistant design, however, these brick-filler wall panels represent a hazard in a shock sufficiently severe to crack and dislodge them. An improvement would be to provide doweling at the contact with columns and beams or some reinforcing rods through the panels to keep them from falling out even if severely cracked.

Small Buildings—This classification considers timber, masonry and concrete structures. Although there were outstanding examples of excellent construction in this group, in general it contained the buildings that sustained the most damage and whose injury was responsible for most of the loss of life.

Timber construction, consisting of wood frame with stucco exterior, behaved well. In many cases two- and three-story flat buildings showed only minor cracks in the stucco along the ground line. In one case a two-story school building of this type moved bodily about a foot on its foundation but showed no external evidence of injury to the frame.

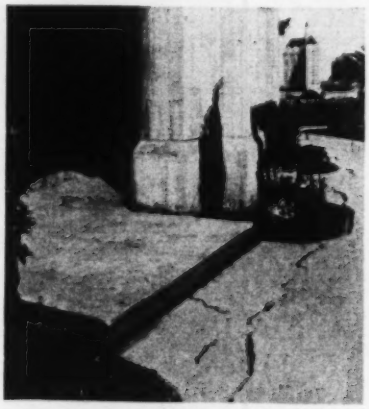


Fig. 7—Around the rear of the Long Beach auditorium the ground sunk about 10 in. Before the quake the ground was level with the top of the sidewalk slab. This concrete and steel structure not only is undamaged but shows no cracks.

Brick masonry received a black mark on its record. This applies to its use in single-story store fronts, building walls, and two- and three-story masonry structures. The glaring weakness was its lack of lateral supporting power and the lack of connection unity. In defense of the material it may be said that many buildings of this type were old; but on the other hand there were examples of new brick structures in bad state of collapse.

An outstanding feature of destruction was the wholesale collapse of parapets or front fire walls of one-story brick buildings along business streets. These walls, often resting on steel lintels or containing a plane of weakness as the result of inserting a metal flashing at the roof line, proved to be particularly susceptible to earthquake destruction. There is code provision requiring ties to the roof members, but these were almost entirely ineffective. In some cases the lateral support provided by the walls kept the ends from dropping out, while in other cases the shaking loose of the fire wall carried out the entire front.

On some two- or three-story structures the effect was the same. Often the top wall was dislodged and the second-story wall remained in place. Fallen brickwork separated into individual

bricks in almost every case, indicating a poor grade of workmanship or of mortar.

It is obvious that serious defects are prevalent in this type of construction, but the question of improvement without materially increasing costs is difficult. The first and simplest means is in the improvement of the quality of the brickwork itself. A code provision could increase the proportion of portland cement in the mortar, although this introduces practical difficulties because masons object to using this type of mortar. A second possibility is to introduce effective ties at the corners and to provide lateral stiffening along the edge of the roof. Reinforced brickwork would seem to offer a third solution.

It should not be concluded that all brick construction was unsatisfactory. Innumerable single-story brick buildings

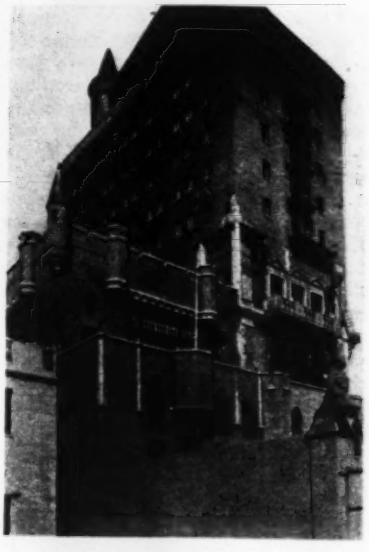


Fig. 8—Pacific Coast Club, Long Beach, a steel-frame structure, suffered its principal damage by having sections of the tile curtain walls cracked and dislodged.

came through without apparent damage, and there were some outstanding examples of three- and four-story brick-wall structures that showed only minor cracking. However, these serve to emphasize the condition of those that failed.

A modification from ordinary brick construction that proved helpful was the introduction of a reinforced-concrete band, or belt course, usually at the floor line to act as a tie. The actual effect of this band, however, was not as great as would be expected. Possibly concrete work in this small quantity may be lacking in quality and again there is the problem of effectively bonding or doweling the band to the brick. However, this continuous tie member adds stiffness and can be classed as a feature of improved design.

Masonry work of concrete blocks, as a rule, indicated comparatively more stable construction, and there are several examples of structures of this type that escaped without injury. Causes for this may include: use of portland cement mortar, irregular size of units that provide some interlocking effect by random laying, and more modern architecture that produces simpler treatment of walls. The comparatively few small modern monolithic-concrete buildings were outstanding in their record of stability and freedom from injury.

Fig. 9—Industrial building wrecked when walls gave way. Elevated steel tanks, as shown in the background, apparently came through the quake in good shape.

School buildings vulnerable

School buildings had such a poor record and are of such general public interest that they are now the subject of a separate investigation. By far the largest number of the school structures were of brick-wall and timber-floor construction. The wholesale wrecking of these buildings, as shown in Fig. 6, was striking and was supplemented by the further shaking off of extensive architectural treatments over entrances, even though the building was not seriously damaged. In the few cases where a monolithic-concrete building was located on the same school grounds, the comparison was so marked as to cause public comment. Apparently two fundamental errors of the past have been the attempt to secure too much building for the money available and the sacrificing of sound construction for architectural effect.

Residences, as a class, did not sustain serious damage, except in instances where the foundation was defective. Brick chimneys, of course, had a high mortality rate over a wide area. House frames, in the majority of cases, were undamaged.

Miscellaneous damage was done to streets, curbs and highways, but the amount was negligible and the results are of no particular interest. A few tall structures showed remarkable stability, including steel water tanks on relatively slender battered legs (Fig. 9) and some concrete chimneys at industrial plants.

Damage to electric utilities

The amount of damage suffered by Southern California Edison Co. properties, representing an investment of about $100,000,000, totaled less than $150,000, according to Fred B. Lewis, vice-president and general manager. The only damage to station property was outside of the steel and concrete buildings and totaled about $25,000. Electric service to Long Beach was interrupted 4½ min., and in Compton 47 min.

A relatively small amount of the damage to Edison property was to buildings and none to steel or concrete structures. The major damage was sustained by outdoor equipment such as switch racks, transformers and batteries. Commercial offices at Long Beach, Compton, Santa Ana and Huntington Park were damaged, as were store rooms at Compton and Santa Ana. The Compton office probably will have to be razed. The others can be repaired. Damage to the Long Beach office was confined to the front of the building, and occupancy of the building was resumed.

The Los Angeles Gas and Electric Corp. loss, as far as now determined, is about $75,000, and is confined to the Seal Beach steam-electric generating station. The building is of steel-frame construction, with hollow-tile and brick walls. The foundations are on piling driven in hard clay. Principal damage was to walls of the building and to one generator unit, a generator spindle of which appears to have shifted due to settlement of the foundation. This phase of the damage has not been estimated. The corporation supplemented the output of an undamaged generator by taking power from the Southern Sierras Power Co. Service by the corporation was further impaired due to the fact that a generating unit at the Alameda St. station was down for overhaul.

The Bureau of Power and Light of the Los Angeles department of water and power reported relatively minor damage, the amount not estimated. There was slight damage to a penstock at the San Fernando hydro-electric plant, and about 3,000 out of 88,000 street lamps were broken. The department also reported the breaking of a water tank of 3,000,000-gal. capacity and the breaking of a water main in the harbor district. The water tank was located in an open field in a section remote from dwellings, and no public damage was done.

—J. I. Ballard

Maintenance and Economics in Railway Development

Intensive convention of A.R.E.A. results in adoption of new rail section and various changes and additions in the Manual

CONCENTRATION on railway maintenance and improvement, in the interests of better service and higher operating economy, is the field now demanding the engineer's attention, since the railway system is now practically completed and no extensive new construction is in prospect. This was the gist of an address delivered by E. F. Williamson, president of the New York Central Railroad, at the annual convention of the American Railway Engineering Association, held in Chicago on March 14 and 15. He pointed out also that the decline in business during the past three years has been largely on the branches and lateral lines. Although increase in traffic may be expected reasonably on main-line routes, such an increase seems less probable on the other routes. This condition points to a reduction in mileage of branch and lateral lines in order to adapt the railway system to modern conditions and requirements. Improvements in service, together with reduction in operating costs to increase the return on investment, are therefore the objects now sought to be attained by the railways through their engineers.

Convention affairs

Brisk though brief discussions on a few of the many subjects presented for consideration enlivened the proceedings, but it is evident that intensive concentration of the convention into a two-day meeting—though necessary for the third time under depressed business conditions—is not entirely satisfactory. Even with limited discussion of the innumerable reports by 26 committees and their subcommittees, no less than nine committees had to present all their reports at a final protracted session.

In spite of continued unfavorable conditions, the attendance was fair, with a total of 605, including 388 members and 217 visitors, as against 643 and 114, respectively, in 1932. Of the 28 committees 26 had their reports printed in advance in seven bulletins totaling about 810 pages.

For the second time, due to adverse industrial conditions, the usual extensive exhibit of railway materials and appliances was omitted. The annual dinner also was replaced by a luncheon, at which Mr. Williamson delivered his address.

With only 30 new members to offset a loss of 442, the secretary's report showed a membership total of 2,311 on March 1, 1933, as against 2,733 in 1932. The financial condition is strong, and the special fund for study of stresses in track amounts to $3,211. Officers for 1933 include: president, W. P. Wiltsee, chief engineer, Norfolk & Western Railway; vice-presidents, John E. Armstrong, assistant chief engineer, Canadian Pacific Railway, and Robert H. Ford, assistant chief engineer, Chicago, Rock Island & Pacific Railway; secretary (re-elected), E. H. Fritch, Chicago. A gold medal was presented to Mr. Fritch in appreciation of his 34 years of service as secretary of the association.

Rails and rail sections

Recommendations for adoption of a new 131-lb. rail section (identical with that of the Pennsylvania Railroad, *ENR*, Jan. 14, 1932, p. 54) and withdrawal of the present 120-, 130-, 140- and 150-lb. A.R.E.A. standard sections now in the Manual were the most important features of the report of the committee on rails. Both were adopted without opposition. It was pointed out that no rails of the 120-, 140- and 150-lb. sections have been rolled and that the 110- and 130-lb. sections have not proved entirely satisfactory in service.

Failures of rails rolled in 1926 were 131.3 per 100 miles of track in 1931, an increase of 20.6 over the 1925 rails in 1930. It is expected that a return to normal or subnormal will be reached when the 1928 rails have completed their five years of service. Transverse fissure failures numbered 7,481 in 1931, an increase of 770 over 1930, making an accumulated total of 58,227. The detector car of the American Railway Association, in trips totaling 16,597 miles for the four years ending with November, 1932, had detected 1,551 fissured rails and a total of 7,187 defective rails, or an average of a fissured rail for each 10.6 miles and a defective rail for each 2.3 miles of track inspected.

A review of the forthcoming sixth progress report of the committee on stresses in railroad track was presented by Prof. A. N. Talbot. This report will cover four sets of investigations: (1) on the Pennsylvania Railroad, to determine stresses in splice bars under electric locomotives at speeds up to 90 miles per hour; (2) on the Chesapeake & Ohio, to determine stresses in splice bars under static loading and the deflections and stresses in rails; (3) on the Missouri Pacific with the "Geo" type of track, in which the rails are secured by bolted clamps; and (4) laboratory tests of rail joints at the University of Illinois. Tests to determine the cause and remedy of transverse fissures and other rail defects, also in progress at the university under the joint direction of the A.R.E.A. and the Rail Manufacturers Association, were described in some detail by Prof. H. F. Moore. They include subjecting rails to bending moment with and without wheel loads, in order to separate the influences of loads and bending. Non-destructive tests are being studied for the purpose of developing a method that can distinguish between sound steel and steel having minute interior defects. The rails are of 110- and 130-lb. sections, rolled at five different mills.

Bridges

Steel, timber and concrete bridges were dealt with in three or four reports. Possibilities of danger to bridges resulting from the creeping of rails were reviewed by the committee on iron and steel structures. The magnitudes of forces that cause creeping are unknown and may be transmitted for considerable distances, so that the anchoring of rails on a bridge may impose longitudinal forces not provided for in the design. In general, rails should be securely anchored on the approaches. If bridge rails creep, they may be anchored to the deck, provided that the movement is not due to uncontrolled creeping on the approaches. If creeping on the bridge or approaches cannot be controlled it may be necessary to introduce switch points and allow the rails to run. This use of switch points, however, was objected to by C. W. Baldridge (Santa Fe) who considered that under all conditions the rails should be held against any creeping. The committee's recommendations were adopted.

Piledriving tests, reported by the committee on wooden bridges and trestles, are said to indicate that the familiar *Engineering News* formula "does not always give a very large factor of safety." In these tests, made by the Missouri Pacific Railroad, the safe loads by the formula were 17.6 tons for a creosoted pine pile and 21.4 and 46 tons for 16-in. and 24-in. concrete piles, while the final loads to obtain equal settlement were 44, 61 and 94 tons respectively. However, the tests were limited and are given only in the way of information. A proposed definition of screw piles was amended at the suggestion of E. E. R. Tratman to explain that such piles are driven by rotary movement and not by impact.

As to the strength of Douglas fir timbers incised to secure deeper penetration of creosote, the committee on wood preservation reported that tests on incised Douglas fir stringers indicate so slight a reduction in strength as to be disregarded in view of the excess strength provided in bridge design.

In relation to concrete bridges, the committee on masonry submitted a paper on the design of rigid-frame bridges, by Prof. Hardy Cross, together with tentative designs for a ballasted-deck concrete trestle and drawings of several types of expansion joints for concrete floors or decks.

Terminals and grade-crossings

Produce terminals, as a comparatively new feature in the handling of perishable freight, were covered in reports of the committee on yards and terminals and the committee on buildings. The former submitted for the Manual a review of the numerous facilities required and of the track layout, driveways, platforms and methods of garbage disposal. The committee on buildings dealt with the design and construction of the terminal building and the temperature required in cold-storage rooms for different commodities.

Application of mathematical study to freight-yard design and operation was an important feature of the report of the committee on yards and terminals. This report presented in detail some graphic methods for distance-speed studies in gravity switching and for determining the grades and profiles of switching humps used in connection with car retarders.

Concave road surfaces

Concave road surfaces in grade-separation subways were suggested by the committee on grade crossings, in order to increase headroom, as the few inches thus gained are important in saving cost. The change from the crowned or convex section would be made at the summit of the approach grade.

Digests of state laws and practices relating to grade-crossings and the division of cost for grade-separations were included in the committee report. In the discussion it was urged strongly by R. H. Ford (Rock Island Lines) that since the highways are taking a considerable amount of traffic away from the railroads, it is not reasonable to charge the latter with a high proportion of the cost of grade-separations, which are important improvements for the highway traffic but which are of little benefit to the railroads. A form of agreement between railroads and public authorities as to grade-separation is being studied by the committee on uniform general contract forms.

Roadway and track

Study of physical properties of soils in relation to the stability of railway roadbed, as a new line of development in economies of railway construction and maintenance, has been commenced by the committee on roadway, which presented a preliminary report on the subject. Specifications for overhaul in grading and descriptions of methods of roadbed drainage, submitted by this committee, were adopted for the Manual. Various subjects on which information was presented included: crib-wall construction, fence-wire investigations (barbed wire 46 years old is still in use), drainage areas and runoff in relation to size of waterway openings, correcting soft spots in roadbed where drainage is impracticable, snow protection on open line and snow removal t yards and terminals.

With its proposed specifications for pipe-line crossings under railways, which refer particularly to pipes carrying inflammable and highly volatile materials under pressure, the committee on roadway presented strong objections from pipe-line companies. The amended specifications were adopted despite the objections.

Progress reports on relation of ballast to rail wear, cost records of track work in gravel and stone ballast, and revised specifications for stone ballast and prepared gravel ballast were submitted by the committee on ballast. Its proposed revision of the Manual as to sub-ballast, particularly eliminating specific depths, was adopted. But as to the suggestion of the committee on roadway that sub-ballast should be considered as a top-dressing of the roadbed, it was insisted by L. C. Fritch (Rock Island Lines) that sub-ballast has the proper function of ballast and should be considered as entirely distinct from the material of the roadbed.

Tie renewal problems

So few ties were purchased in 1932 that there is prospect of the offer of quantities of ties of doubtful quality when demand again increases, according to the committee on ties. Careful inspection of each tie and no acceptance of ties as stacked for seasoning are means suggested to maintain the quality necessary for economic service.

The committee's review of substitute ties indicated continued decreasing use of such ties, although the Delaware & Hudson has built a plant for the manufacture of ties from old rails and has 52,888 of these in track. A list of all experiments with substitute ties since 1879 was included. The annual record of tie renewals was given, and the committee announced its plans for one-mile test tracks laid with ties 8, 8½ and 9 ft. long, for comparison of maintenance costs. Tabulated service records of treated ties were included in the report of the committee on wood preservation.

Changing conditions in railway track work were noted by the committee on economics of railway labor in a report on maintenance-of-way by large special gangs, as practised on several railways. In general this has proved more economical than the ordinary section-gang system. Schedules of gang organization for rail renewal, with details of equipment and cost, were given for the Pennsylvania, the Chesapeake & Ohio and the Louisville & Nashville. On account of changed conditions and increasing use of mechanical equipment in track work, the committee recommended the withdrawal of methods of making time studies, now in the Manual. This action was agreed upon.

Motor trucks used in engineering and maintenance work were found to number 150 on 34 railroads and to range from ½ to 5 tons in capacity. But while some roads report their use advantageous, others find them of no particular benefit. The committee considers that they are of definite advantage and economy under certain conditions of location and traffic: (1) at terminals, where traffic hampers the operation of motor cars and hand cars; (2) for work at property that is at a distance from tracks; (3) around junctions where short cross-country trips enable a crew to cover territory on more than one line; and (4) on lines paralleled by highways, when the crews can cover more mileage by motor truck than by motor-section car.

Along similar lines was the report of the committee on maintenance-of-way work equipment, giving itemized costs of the use of crawler tractors in such work as widening cuts and fills, ditching, cleaning culverts and waterways and laying rails. The use of tie adzing and boring machines, tie tampers and spreader cars for ditching was also included.

The high economy and practical value of snow-melting devices at switches and other moving parts in terminal yards was discussed at some length. By their use, regular forces of 8 to 20 men have kept the tracks open during heavy snowfall, where otherwise from 200 to 500 extra laborers would have been required.

Record-keeping

A revised series of some 500 graphical symbols for use on drawings was submitted for the Manual by the Committee on records and accounts. A study of appraisal and operating records for facilities used jointly by two or more railroads is in progress. A review was given of present forms for gathering data used in keeping up to date the railway valuation and property records, but this was without any recommendations, since a new system of accounting is proposed tentatively by the Interstate Commerce Commission.

Water supply

For deep-well pumping at railway water stations the committee on water service and sanitation listed three types: (1) displacement or plunger pumps, for 50 to 300 g.p.m. and depths not exceeding 300 ft., over-all efficiency 40 to 60 per cent; (2) turbine pumps, for 50 to 6,000 g.p.m., depths to 500 ft. or more, efficiency 60 per cent; (3) air-lift, for greater depths than are suitable for other pumps and especially applicable to wells that are crooked or produce much sediment, efficiency 25 to 40 per cent.

Book Reviews and Notes

A Monthly Commentary on Current Additions to the Civil Engineer's Library

♦ ♦ ♦

Municipal Economies

A SURVEY OF MUNICIPAL GOVERNMENT OF INDIANAPOLIS—By the late B. J. T. Jeup, former city engineer, Indianapolis, Ind. Paper; 6x9 in.; pp. 115. Privately printed.

This survey was made by Mr. Jeup to bring up to date a survey made in 1917 by the Bureau of Municipal Research, New York. Mr. Jeup made the survey without expense to the city, with a view to making it possible for the city to grasp the present opportunity to eliminate waste, but at the same time to guard against indiscriminate curtailment of essential services. Fourteen cardinal points in the plan are advocated for an ideal government of Indianapolis. Particular attention is given to the fiscal policies, civil service and especially the set-up of the various public works and sanitary departments so as to effect better coordination. A budget for every department was prepared in which a saving under the reduction of overlapping the uncoordinated units of $750,000 is indicated. Mr. Jeup died shortly after completion of his efforts to reduce the tax burden. His private printing of 500 copies of this booklet for a selected distribution was the last expression of his earnest endeavor to promote the idea of sound economy in municipal government.

Pioneering in Water Contracts

THE HOOVER DAM POWER AND WATER CONTRACTS AND RELATED DATA with Introductory Notes by Ray Lyman Wilbur and Northcutt Ely. Cloth; 6x9 in.; pp. 674; Copies may be obtained from the Superintendent of Documents, Washington, D. C.

Much pioneer work bearing on water and power rights as between states as well as between the federal government and the states lies back of the agreement and legislation that made possible the construction of Hoover Dam and laid the basis for future construction of the All-American Canal. The Colorado River compact, signed in November, 1922, by representatives of the seven basin states, Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming, after much controversy, abandoned the original plan of dividing the water among the seven states individually and allocated it between the upper and lower basins, leaving to future judgment the division of water within each basin. The compact was ratified by all of the states except Arizona. Ratification by six of the seven states was followed by the passage of the Boulder Canyon Project Act, approved December, 1928.

Assembled in the volume noted here is a summary of the negotiations leading up to the Boulder Canyon Project Act, copies of the contracts for Hoover Dam power and water, together with details of the negotiations leading up to the contracts, either signed or pending, an analysis of the contracts, data submitted to House and Senate committees in support of the first appropriation for the work, and significant opinions on questions of law. Other important documents also are included in the appendix or are covered by references.

Old Ideas Revived

Reviewed by M. N. Baker
Upper Montclair, N. J.

WHAT IS TECHNOCRACY?—By Allen Raymond. Cloth; 5x8 in.; pp. 180. Published by Whittlesey House, McGraw-Hill Book Co., New York and London. $1.50.

INTRODUCTION TO TECHNOCRACY—By Howard Scott and others. Board, cloth back; 6x8 in. Published by The John Day Co., New York. 90c.

NEARLY forty years ago George S. Morison chose for the subject of his presidential address before the American Society of Civil Engineers, "The New Epoch and the Civil Engineer" (*Engineering News*, June 27, 1895, p. 414). After considerable amplification the author made his essay ready for the print early in 1898, but through modesty put it away. Immediately after his death in 1903 the essay was published with the broadened title, "The New Epoch as Developed by the Manufacture of Power." Since then many writers have taken up the theme, modifying the treatment to accord with further changes in the substitution of mechanical for human power, with their views of economics, industry and of society. Latterly, stress has been laid on the fact that it is not merely the manufacture of power but also the utilization of nature's great store of energy that has made it possible for a single machine to do the work that formerly required thousands of human beings, all through the inventiveness of the engineer and other technologists.

Twenty-five years after Morison's pioneer essay, a group of technically trained men began an energy survey of the North American continent. Little or no publicity was given to their work until late in 1932, when technocracy was brought to the front by Howard Scott and his associates. As presented, its chief points were the replacement of the dollar by the erg and the control of industry by engineers—failing that, chaos.

Of a half-dozen recent books on technocracy most inquirers will find all they need to know in "What Is Technocracy?" by Allen Raymond, and "Introduction to Technocracy" by Howard Scott and others, subtitled "The Only Authorized Presentation of the Subject."

A careful reading of both books and of many others dealing with technocracy and related subjects indicates to the reviewer that inadequate, premature and sensational as the early pronouncements on technocracy were, many of its facts deserve serious consideration.

Transport Problems

THE AMERICAN TRANSPORTATION PROBLEM—By Harold G. Moulton and associates. Paper; 5x8 in.; pp. 915; photographs, line drawings and tables. Published by the Brookings Institution, Washington, D. C. $3.

BACK of the conclusions of the National Transportation Committee as to what should be done to improve and stabilize transportation in this country (*ENR*, Feb. 23, 1933, p. 262) stands a mass of data assembled by the Brookings Institution at the request of the committee. For the committee's convenience those data were marshaled in a systematic manner and analyzed by the research staff of the institution and a group of specialists recruited for the purpose, all under the direction of Harold G. Moulton, president of the institution. The analysis here is presented in book form, together with the findings of the National Transportation Committee, for the convenience of the general public in studying the country's transportation problem.

The great bulk of the material presented in the book relates directly to problems of the railroad, first because the railroads form the backbone of the transportation system of the country, and second because it was the demoralized condition of railroad finances that resulted in the setting up of the National Transportation Committee. However, a considerable amount of space is devoted to highway development and financing, to a discussion of such current questions as who pays for the highways, to waterways, motor-vehicle taxation, coordination of rail and motor transport, air transport, oil and gas pipe lines, to the problem of terminal unification, the relation of transportation to city planning and to the reorientation of our system of transport regulation. There also is a selected bibliography of publications relating to the current transportation problems.

At the present time when transportation problems are so much to the fore

this book will be found of special value to the reader who has not the time to search out and read the great mass of published material on the subject and yet who wants to obtain an accurate picture of the esential facts bearing on the subject. The fact that one may not agree with some of the conclusions expressed does not detract from the value of the factual presentation.

Miscellaneous Notes on Booklets and Reprints

THE HYDRAULIC RAM is the subject of a separate print, Vol. 3, No. 1, University of California, Publications in Engineering. The price is $2.

REDUCTION OF BACTERIA IN OPEN AND CLOSED FILTERS; Bulletin No. 41, Engineering Experiment Station, Pennsylvania State College, State College, Pa.

STATISTICS OF AUTOMOBILE ACCIDENTS for 1932 compared with those of previous years are given in a booklet put out by the Travelers Insurance Co., Hartford, Conn., entitled "They Call Us Civilized."

PREPARATION OF ANNUAL REPORTS of public works departments is the subject of a pamphlet entitled "How to Prepare an Annual Public Works Report," prepared by the Committee on Uniform Street and Sanitation Records, 923 East 60th St., Chicago, Ill.

VARIATIONS AND CONTROL OF SALINITY in the Sacramento-San Joaquin delta and in Upper San Francisco Bay, a report on the state water plan, has been published by the division of water resources, department of public works, Sacramento, Calif., as Bulletin No. 27. The report is freely illustrated with charts and colored maps.

REINFORCED-BRICK MASONRY BEAMS tested to determine their resistance to failure by diagonal tension is the subject of Research Paper No. 504, Bureau of Standards, entitled "Sheer Tests of Reinforced-Brick Masonry Beams." Copies may be obtained from the Superintendent of Documents, Washington, D. C., for 5c.

UNEMPLOYMENT RELIEF FUNDS for public works, a summary of the unemployment relief work sponsored by the architectural and engineering societies of Boston, has been published in pamphlet form and may be obtained from the Emergency Planning and Research Bureau, Inc., 182 Tremont St., Boston, Mass. Price $1.

ABBREVIATIONS FOR SCIENTIFIC AND ENGINEERING TERMS, American Tentative Standards, have been published by the American Society of Mechanical Engineers, 29 West 39th St., New York City. Other organizations interested in the preparation of these standards are the American Association for the Advancement of Science, American Institute of Electrical Engineers, American Society of Civil Engineers and the Society for the Promotion of Engineering Education. These tentative standards were approved by the American Standards Association in November of last year. The price of this pamphlet is 40c.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

ALUMINUM IN ARCHITECTURE—5x8 in.; pp. 234; photographs, tables and line drawings. Published by the Aluminum Company of America, Pittsburgh, Pa. $1.

ARC-WELDED STEEL-FRAME STRUCTURES—By Gilbert D. Fish. Cloth; 6x9 in.; pp. 401; photographs, tables and line drawings. Published by McGraw-Hill Book Co., Inc., New York and London. $5.

ARMY ENGINEERING—By Colonel William A. Mitchell, U. S. Army. Third Edition. 4x7 in.; pp. 329; photographs, line drawings and tables. Published by The Society of American Military Engineers, Washington, D. C. $3.

COLORADO RIVER CONTROVERSIES—By Robert Brewster Stanton. Cloth; 6x9 in.; pp. 232; photographic illustrations. Published by Dodd, Mead & Co., New York. $3.

DESIGNING FOR ARC WELDING—Second Lincoln Electric Arc Welding Prize Papers. Edited by A. F. Davis. Paper; 6x9 in.; pp. 415; photographs, line drawings and tables. Published by the Lincoln Electric Co., Cleveland, Ohio. $2.50.

DER EISENBETONBAU—By C. Kersten. Paper; 5x7 in.; pp. 262; tables and line cuts. Published by Wilhelm Ernst & Sohn, Berlin, Germany. 8 RM.

THE GREAT DELUSION: Some Facts About Government in Business—By Ernest Greenwood. Cloth; 6x8 in.; pp. 238; Published by Harper & Brothers, New York and London. $2.50.

HANDBUCH FÜR EISENBETONBAU: Behälter Maste, Schornsteine Rohrleitungen—Paper; 7x10 in.; pp. 80; photographs, line drawings and tables. Published by Wilhelm Ernst & Sohn, Berlin, Germany. 5.50 RM.

HYDRAULIC MACHINERY—By Daniel W. Mead. Cloth; 6x9 in.; pp. 396; diagrams and tables. Published by McGraw-Hill Book Co. Inc., New York and London. $4.

IRON AND STEEL (A Pocket Encyclopedia)—By Hugh P. Tiemann. Flexible; 4x7 in.; pp. 590; diagrams and tables. Published by McGraw-Hill Book Co. Inc., New York and London. $4.

MODERN CONNECTORS FOR TIMBER CONSTRUCTION—Prepared by the National Committee on Wood Utilization and the Forest Products Laboratory. Paper; 6x9 in.; pp. 147; photographs, tables and line cuts. For sale by Superintendent of Documents, Washington, D. C. 15c.

PUBLIC UTILITY REGULATION—By William E. Mosher and Finla G. Crawford. Cloth; 6x9 in.; pp. 612; tables. Published by Harper & Bothers, New York and London. $5.

SYDNEY HARBOUR BRIDGE—Cloth; 9x12 in.; pp. 89; photographs and line drawings. Published by Dorman Long and Co., Ltd., Middlesbrough, England.

Letters to the Editor

Architecture Is Not Engineering

Sir—The recent earthquake in southern California again gives evidence of the nature of many buildings, the form of which violates every rule of safe construction based upon the experience of the past. This remark applies with considerable force to school buildings. The story is the same as told by the Santa Barbara earthquake of 1925. Had the schools been in session, hundreds of children would have lost their lives.

Presumably the school buildings in Long Beach were constructed under the direction of architects, as the state law requiring the registration of architects has been in existence for a number of years. It has been the claim of architects that registration of their profession would produce safe buildings. It has also been the constant endeavor of the architects of California to shut out structural engineers from the design and construction of buildings. A bill now before the California State Legislature would practically prohibit engineers from engaging in such work.

The evolution of the art of building in recent years in America has made necessary the services of engineers, especially in the larger structures. More and more the architects have abdicated their functions as designers of construction and have devoted themselves mainly to the arrangement and appearance of buildings. If the methods of construction used in numbers of buildings are a criterion, a part of the architectural profession is incompetent to design the structural parts of buildings.

Instead of passing laws to eliminate the engineer from construction of buildings, if any laws are passed they should provide that no building be constructed the structural design of which has not been entrusted to a competent engineer. Only in this way can buildings in this earthquake state be made reasonably secure.

The lesson in southern California taught by the recent earthquake is largely a restatement of the lesson learned in previous shocks. It is unfortunate that the profession of architecture, which has charge of building construction, is not competent to handle the problem. J. D. GALLOWAY.

San Francisco, Calif.,
March 16, 1933.

Engineering News-Record

EDITOR—F. E. Schmitt. EDITORIAL STAFF—V. T. Boughton, W. G. Bowman, F. W. Herring, C. S. Hill, H. W. Richardson, W. W. De Berard, N. A.Bowers, J. I. Ballard.

Editorial and Publishing Offices at 330 West 42d St., New York; 520 North Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, London, England.

Subscription price $5 per year in the United States; foreign rates on application.

Copyright 1933 by McGraw-Hill Publishing Co., Inc.

MARCH 23, 1933 Volume 110 No. 12

Flood-Time Again

THIS WEEK'S high flood in the Ohio River comes twenty years almost to a day after the memorable Central States flood of 1913, which centered at Dayton in the Miami River basin but extended over all of the Central States area. Out of that flood grew the Ohio conservancy law and the protective works of the Miami Conservancy District, works that then set a precedent in flood-protection planning and that still remain a model. The countrywide attention directed to flood hazards by the events of 1913 remained active long enough to cause many other communities to study their situation. A few went farther and undertook protective construction. On the whole, however, interest in the subject soon waned, and floods were forgotten until the next high water. In consequence, flood danger still threatens many valleys, and preventable loss of life and property destruction recur periodically. Only a small beginning has been made in flood-protection construction. The vast field of work still waiting action illustrates well the truth that public improvements lag far behind the need.

Sewer Construction and Employment

THERE IS satisfaction in reading the report of sewer construction undertaken in Newton, Mass., to give work relief to the unemployed. Construction with assigned welfare labor is not easy to handle by contract, but at Newton full success was attained. As to such a project's effect on employment, some essential factors require thought. Specifically, the question arises whether the project would have to be built apart from the relief need. If so, then there is no net gain in employment, and nothing is accomplished except to deprive regular construction workers of their income and turn it over to the men on the welfare roll. Such a shift brings with it no increase in power to purchase the products of private industry; it can do no more than rob Peter so that Paul may be paid. Indeed, to the extent that in such a system the wages paid to the relief labor would be lower than those paid to regular workers, a net loss of purchasing power would be sustained. But in so far as the Newton project was undertaken primarily as a welfare relief expedient, it contributed to general recovery by increasing the wage total.

Bituminous Finisher Proves Worth

ONE OF the two strongholds of hand labor—laying brick and spreading asphalt for pavement—is being rapidly demolished as machine spreading demonstrates its proficiency. The successful placing by machine of both cold and heated rock asphalt at either a fraction of an inch uniform depth or in depths of from ½ to 3 in. on irregular base, as described last week, finally establishes the conviction that machine spreading and finishing have reached the point of practical success, and that further advance consists in refinement of equipment and procedure. The evidence of the Indiana operation described shows also that machine spreading increases output. Similar evidence has accumulated from previous experience with other types of machine in a number of operations. In bituminous road work the finishing machine has in scarcely three years proved its right by speed and versatility to a permanent place in the road-builder's stock of regular equipment.

A Widely Studied Subject

SENATOR PITTMAN'S comment on the national transportation problem on another page is indicative of the wide study that is being given to the question at this time. In his search for information that might be of value to the Senate interstate commerce committee in its analysis of railroad legislation, he has carried his studies to Germany, where ideas as to coordination of rail and motor transport have been carried to limits not found possible here under private initiative. Even though European methods may not be found fully applicable, however, they deserve study. The essential thing in our planning is that we set up a system whereby the public gets the maximum benefit from the various forms of transportation that are available for its use. Much the same point was made by the National Transportation Committee in its recent report based on an extensive study of transportation data assembled by a group of specialists of the Brookings Institution in Washington. That information has now been made available to the public in book form, as noted on p. 384 in this issue. It should be helpful to the many who in the next few months will wish to follow the progress of legislation to solve the transportation problem.

Water-Tunnel Experience

A RARE opportunity was presented to the engineers of the Chicago water department when the Blue Island Ave. water tunnel, built in 1907, was unwatered last year for construction purposes. During the quarter century that the tunnel has been carrying Lake Michigan water no one had seen its inside. Its condition could only be speculated on. Was the concrete being eroded by the gritty, unfiltered water? How sound was 25-year-old, 1:3:6 concrete, made at a time when concrete construction technique was primitive? Were any structural weaknesses developing? The department's engineers took advantage of the opportunity and examined the tunnel. Two surprises were in store for them. First, erosion was not in evidence at all, and second, and most striking, thousands of accretions of calcium carbonate were found adhering lightly to the surface, apparently formed by seepage water dissolving out the high-calcium cement compounds. It is interesting to note that despite the great loss of strength-giving compounds the tunnel gave few signs of structural distress. The observations made during the inspection are highly reassuring to everyone concerned with either water supply or tunnel maintenance. But they also teach anew the lesson that nothing less than wholly dense concrete construction will serve in the long run.

The Foundation of Recovery

WHAT has been accomplished in the last three weeks of reconstruction is fundamentally important. In the stirring events of this brief period money has been set in motion again, government costs have been cut, the national credit has been re-established. Throughout the country a faith and confidence long unknown have been awakened. Thus, stone by stone, a foundation for recovery is being laid.

For any just appraisal of this remarkable situation it is necessary to recall some well-known facts. Confidence alone is unable to revive industry or to pay the overhead of an idle country, and there is no possibility of progress without work. But business and industry cannot provide this employment until an initial impulse is given, and this impulse—as was forcefully restated by Secretary of War Dern a few days ago—is obtainable only through public-works construction.

Last week in this column we referred to the great volume of state, city and county improvements deferred since 1929 because of steadily growing financial pressure and to the unfortunate fact that R.F.C. funds have not been widely utilized to improve the situation. We pointed out that both employment and money are available to give that impulse which industry needs for its early recovery.

But there are formidable obstacles in the way of utilizing these resources. Everywhere, the call for economy, progressively growing stronger during the past two years, has led to reduction of public expenditure and now stands in the way of all efforts to undertake or continue improvements. The stubborn argument that relief is cheaper than construction retains force so long as the construction dollar necessarily goes outside the town or county that spends it, while the full amount of the relief dollar is applied locally.

Undertaken with the spirit of a national movement, resumption of construction by every community would distribute throughout the whole country the influence of the construction expenditures. It would not only make each dollar effective in full amount, but the dollar's passing from hand to hand would cause it to function many times over as an active agent of business recovery. The effect would be to consolidate the gains so far made and to give practical reality to the new-found confidence.

What will a public-works re-employment campaign cost and what will it return? These questions seek an answer before full public support can be expected. The answer in brief is that it will cost little or nothing and that the return will be large. The cost is merely that of organizing and administering the work; the construction expenditure is covered by credits, to be repaid by interest and amortization through a period of years. Its earning power, on the other hand, lies in three directions: the useful wealth that it creates, the industrial and business resumption that it brings about, and the tax returns which the new wealth and activity will cause to flow into the public treasuries. It has been calculated that the tax returns alone will pay for all the cost of construction through the multiplied business activity that the construction enterprise and employment produces. But the most decisively important effect is the impulse toward restoration of normal industry and business—the priming of the business pump.

That the imminent need for undertaking a broad employment program through public construction is appreciated by the government has become evident from Washington reports. The Civilian Conservation Corps' proposal, just announced and a relief measure only, is to be followed by a plan for reviving local public-improvement construction. Any such plan, obviously, will depend for its success on the thoroughness with which these improvements are planned. Accordingly, if the people at large and their local governments throughout the country will review their deferred improvements and make ready to put them under way quickly, they can make a vital contribution to carrying forward the work begun at Washington this month.

Schools, at Least, Should Be Safe

NO FEATURE of the recent California earthquake is so important or so damning as the wholesale destruction of school buildings in Long Beach and other Los Angeles County towns. That such construction as was embodied in some of these structures could be permitted in buildings designed to house school children is an indictment of every community concerned.

Reason, though certainly not justification, may be found for the extensive wrecking of small stores, apartments and similar structures; here the short-sighted and selfish attitude of home-town boosters and real-estate interests is the controlling influence, little restrained by weak building codes and inspection. But even the most callous of these interests would not apply the same reasoning to school buildings and places of public assembly. Yet the wreckage speaks for itself.

Some day an earthquake—or a violent storm—is going to strike one of our cities during school hours. It might have done so at Long Beach, but by pure good fortune did not. The cities of Long Beach, Los Angeles, Compton and Huntington Park have been gambling. They have known for years that an earthquake might come any day, and they have long known what will happen to loosely built structures in even a moderate quake. They gambled knowingly or heedlessly. Though they won, next time Nature may not be so kind.

What is the remedy? It is not a need for greater earthquake or wind-design knowledge. This knowledge, though not perfect, is ample, as evidenced by the many buildings that resisted the California earthquake, including some recently designed schools. That a building must have a complete and strong frame, and that walls, roof and minor features must be tied to this frame is well understood. The present case is not primarily a technical question at all. Rather the need is for a public demand that schools be made the safest of structures, so safe in fact as to be places of refuge. And not only should all new schools be built with such an end in view, but every existing building should be examined, and if not adequate should be strengthened or razed.

It is not the purpose here to consider in detail what types of construction should be used or prohibited in California. They are well known to engineers if not to some of the architects who designed the collapsed schools. Since the means are available for making schools safe, southern California should immediately embrace them and by bold example not only erase the indictment that now is so plain but should afford other parts of the country an example to emulate. If shoddy construction must persist in some classes of structures, school buildings should not be among them. They, at least, should be safe.

NEWS OF THE WEEK

Ohio River Floods Near High Record of Twenty Years

FLOOD stages in the Ohio River, where the river gages have been rising over the past two weeks, have reached a point generally above any record established since the flood of 1913. At Pittsburgh, unless current rains bring new floods down the Allegheny and Monongahela rivers the flood peak has passed with the flood having reached 29.6-ft. stage or about the stage reached in 1927 and close to the 30.4-ft. stage of 1929.

Reports from Wheeling, West Va., indicate that although the first crest has passed, a second crest is approaching. Last week a stage of 41 ft. 8½ in. was reached or six feet above flood stage. In the 1913 flood a stage of 52 ft. 2 in. was recorded.

At Parkersburg a stage of 42 ft. was reported, also 6 ft. above flood stage. The Weather Bureau in Washington, on March 19, predicted a possibly higher rise due to the heavy rains over West Virginia during the week-end. As the water from the recent rains would reach the main river between Parkersburg and Evansville, Ind., coincident with the flood crest higher stages are expected there than in the upper river.

At Portsmouth, Ohio, the river reached the 56-ft. stage on Sunday. The dike protecting the city is designed for a flood of 60 ft.

At Cincinnati the river is reported as still rising, one crest having passed. High water along the river front there has caused the railroads to abandon their terminals on the low lands and make use of the partly-completed union station.

The Weather Bureau predicts that the flood crest will reach the Mississippi at Cairo by March 25 but abnormal high water in that stream is not expected to result.

Catskill Bridge Act Amended

The act passed by the New York State Legislature last year to provide for the construction of a bridge over the Hudson River at Catskill, N. Y., has been amended by the legislature now in session to meet the requirements of the Reconstruction Finance Corporation as a condition to loaning money for the bridge. The act provides for the creation of the New York State Bridge Authority and invests the bridge authority with power to issue bonds, construct a bridge and to maintain and operate it as a toll bridge together with the bridge at Poughkeepsie. The bridge authority recently applied to the Reconstruction Finance Corporation for a loan to finance the construction of the Catskill bridge but the directors of the R.F.C. would not approve the loan until changes which it deemed desirable had been made in the law.

New York Starts Plans for Plant to Treat Sewage in Brooklyn

Preliminary work on a sewage treating plan on Avenue Z at Bragg St. in Brooklyn, New York, was authorized recently by the Board of Estimate. The plant is one of a number in the city's program for sewage treatment. It will have an outlet off shore in Rockaway inlet and is designed to reduce sewage pollution at bathing beaches in the Coney Island and Sheepshead Bay districts.

More Bids Called for Sections of Colorado River Aqueduct

The Metropolitan Water District of Southern California is calling for bids on April 17 on the Iron Mountain, Coxcomb and Cottonwood tunnels, a total of 14.6 miles estimated to cost $8,000,000. As noted last week, the district will open bids on April 3 for the Valverde and Bernasconi tunnels.

Bids also have been called for April 4 for the construction of about 60 miles of 5, 6 and 8-in. pipe line to supply water for the construction of the eastern end of the aqueduct line, also for three 300,000 gal. reservoirs for the line. These reservoirs will be lined with pneumatically placed concrete. The contractor is to supply all material except pipe and fittings.

Dearborn, Mich., to Vote on Independent Water System

A proposal for a $2,093,000 bond issue to provide funds for a new water supply system for the city of Dearborn, Mich., will be submitted to the electors of that municipality at the April election. The city council's action in directing the proposal followed a study of preliminary reports by Fred R. Storrer, city engineer of Dearborn and by Hubbell, Hartgering and Roth, consulting engineers, Detroit, on a proposed independent water supply system for the city and on the estimated cost of filtered water pumped through feeder mains to the present distribution system, based upon a 30-year period. Dearborn now purchases its water from Detroit.

If the bond issue is passed by the electors, it is proposed to sell part of the bonds to the Reconstruction Finance Corporation.

The system proposed by the consulting engineers provides for drawing water from the Detroit River through a submerged intake near the center of the river opposite the Fort Wayne military reservation. A river tunnel from the crib to shore and a land tunnel across the Fort Wayne property and along Detroit and Dearborn streets will bring water to Schaefer Road at Airport Drive. An emergency intake to the Rouge River also is included. A low lift pumping station will lift the water from the intake tunnels to the filtration plant and water storage, and high lift pumps and feeder mains will connect with the city's existing distribution system.

Two Large Loans For Slum Clearance and Parks Approved

TWO LARGE loans for work in New York State were approved by the Reconstruction Finance Corporation on March 21. One of $8,000,000 is for a slum- clearance housing project in New York City known as Knickerbocker Village and the other, $5,050,000, is for development work at Jones Beach on Long Island.

Knickerbocker Village is a project of Fred F. French Operators, Inc., well-known apartment house builders and owners in New York City. Public announcement of it was made in December 1931 after the company had acquired the greater part of a twenty-five block area bounded by Roosevelt St., East Broadway, Pike St. and South St. (fronting on the East River between the Brooklyn and Manhattan Bridges). The project will provide 1,630 apartments and over 6,000 rooms in two 12-story fireproof structures covering an area of 96,323 sq.ft. or 43.8 per cent of the 5-acre plot. Its total cost is estimated at $9,500,000.

The proposed work at Jones Beach, a project of the Long Island State Park Commission, includes additional bath house facilities for 15,000, a swimming pool to accommodate 1,400 people, and a one-mile extension of the board walk.

In November of last year the R.F.C. approved a loan of $3,957,000 to the Hillside Housing Corporation, New York, for a housing project in the Bronx but the loan never has been made, chiefly because city officials opposed the project as a new undertaking in a region where there was an excess of housing facilities rather than as a project for clearing out antiquated and unsanitary tenements.

Applications for R.F.C. Loans

Applications for two loans for the city of Ludington, Mich., have been filed with the R.F.C. by the Michigan Committee for Trade Recovery. One loan application is for $223,000 to finance the construction of a public wharf, dock and boat basin and the second is for $119,500 for the construction of a recreational field including three concrete grandstands, a concrete skating rink and tennis courts.

Construction of a canal from Birmingport on the Warrior River in Alabama across to Guntersville on the Tennessee River for a connection with the Mississippi-Ohio River barge canal system is proposed by the Birmingham and Tennessee Lake Canal Co., recently organized in Tennessee. Application for an R.F.C. loan is being considered.

Cushing, Okla., plans to apply for a loan of $300,000 to purchase an electric light plant and construct a distributing system.

Miami, Fla., is preparing an application for a loan of $470,000 for improvements to the city's water supply system.

Projects Financed by R.F.C. Free of Tax in Washington

A law has just been approved by the governor of the state of Washington which provides for the exemption from taxation of projects built under the provisions of the emergency relief and construction act of 1932 to the extent that they are financed by the federal government. In determining valuation for taxation purposes, assessors are instructed by the act to deduct the amount of the loan unpaid to the federal government at the time the assessment is made.

Permit to Bridge York River Goes to Independence Company

The Virginia State Highway Commission on March 10, granted a permit to the Independence Bridge Co. for the construction of a highway toll bridge over the York River between Gloucester Point and Yorktown, Va. The estimated cost of the project is $1,600,000 and R.F.C. financing is contemplated.

Previous permit granted to York River Bridge Corp. for this bridge has expired. Robinson & Steinman, New York City, are the engineers for the owner the Independence Bridge Co., care of P. K. Schuyler, 1024 Vermont Ave., Washington, D. C.

Law to License Contractors Passed in the State of Idaho

Under a law recently passed by the legislature of Idaho and approved on March 13, all contractors desiring to bid on any public works within the state must be licensed by the commissioner of public works. The license must be obtained at least 30 days before the bid is submitted.

Applicants for license must submit a statement of experience and finances on a standard form approved by the Joint Conference on Construction Practices and the Associated General Contractors of America, must pay a $100 license fee and submit references. The annual renewal license fee is $50.

Money received from the license fees is to be used to administer the license law and any excess remaining is to be paid into the state highway fund.

Large Public Works Program To Be Started in Mexico City

As a result of President Rodriguez having approved an increase in the budget for the municipal government of the federal district of Mexico, the government of Mexico City will soon undertake the largest public construction program of recent years. Local citizens have made cash and land donations equivalent to 2,860,000 pesos and a local construction company has made available 2,500,000 pesos of material so that the city will have a total of 5,768,000 pesos for the work, or nearly $2,000,000.

The work to be undertaken includes improvements and repair to the aqueduct bringing water to the city and the extension of the distribution system, paving and street widening, including the Zocola, the principal public square, and the construction of a school on the site of the historic Belen prison.

Columbus Council Endorses Chemical Treatment for Sewage

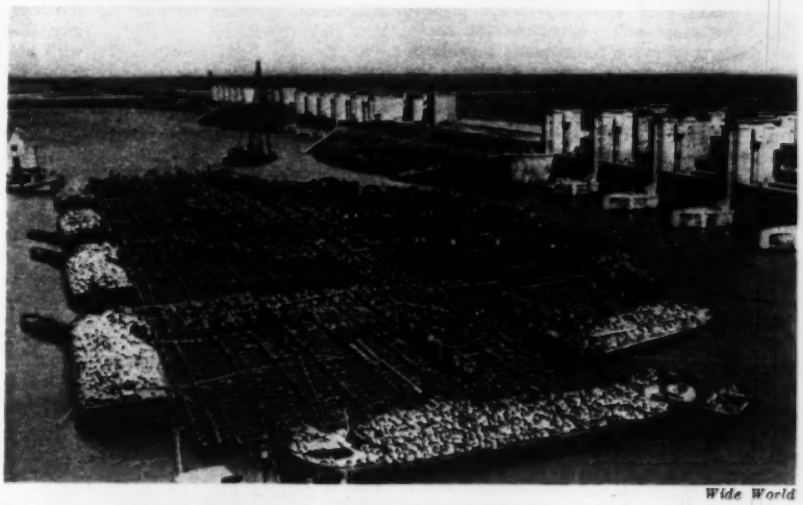
On March 15, the city council of Columbus, Ohio, by a vote of 6 to 1 went on record in favor of the plan submitted by O. L. Barneby of the American Solvent Recovery Corporation to treat the city's sewage by a method involving chemical precipitation, activated sludge, trickling filters and chlorination. The city is under orders from the state department of health to present an acceptable plan for ending the pollution of the Scioto River before April 15. Financial difficulties have prevented the construction of an activated-sludge plant designed by the city engineers.

The existing trickling-filter plant at Columbus has been badly overloaded for some years. It was designed to treat 15 million gallons daily and has been receiving 40 m.g.d. or more for some time. The resulting bad condition of the Scioto River caused the state health department in 1927 to order the city to remedy the situation. Accordingly, a modern plant designed to use the activated-sludge process was designed to replace the old plant and a proposed bond issue of $3,500,000 was put before the voters last fall. The bond issue, however, was turned down at the polls. Although this blocked the financing of the proposed plant, a decision of the state supreme court in December in a similar case held that the health department's orders were nevertheless mandatory and indicated that the city would have to make more adequate provisions for sewage treatment regardless of financial difficulties.

Revisions of the sewage disposal plans were made by the city engineers to allow piecemeal construction of the new plant, with the possibility of using welfare labor. Plans were also submitted by outside firms, including the Filtration Equipment Corporation and the American Solvent Recovery Corporation. One of the proposals of O. L. Barneby, of the latter company, was to take over and remodel the existing plant and operate it for seven years at a charge of $21.40 per million gallons. This plan was declared illegal.

Late in January the city council rescinded its order of July 27, 1931, under which the plans for the activated-sludge plant had been prepared. At about the same time they received another proposal from Mr. Barneby which comprised the installation and sale to the city at a price not to exceed $800,000 of a chemical and activated-sludge type plant to be followed by a seven-year operating contract at $15.45 per million gallons. The operating cost of the city-designed activated-sludge plant was estimated to cost $11 per m.g. An additional plan, submitted by K. B. Allen, of Dayton, was for a process involving prechlorination, sedimentation, sludge digestion and trickling filters that was estimated to cost $985,000 to construct and $4.85 per m.g. to operate.

On March 15 the city council endorsed the treatment method sponsored by Mr. Barneby. It calls for chemical precipitation with lime and other chemicals, activated-sludge treatment for the settled sewage, followed by further trickling-filter treatment chlorination and final sedimentation. No form of contract arrangement has been decided on, however. The approval of the state department of health has also to be obtained before the treatment plan can be finally adopted. The mayor is opposed to the council's preferred treatment method and favors the alternate plan of the city engineers to build an activated-sludge plant by step-by-step construction, estimated to involve an expenditure of $711,000 over two years. The new construction would care for 25 m.g.d. and the existing plant would be utilized, with chlorination, to bring the capacity to 40 m.g.d.



Wide World

PROTECTIVE MAT BEING SUNK AT ZUIDERZEE SLUICES

The government of Holland has found it necessary to provide additional protection to reduce scour in front of the sluices through the recently-built dike cutting off part of the Zuiderzee. As described in our issue of Dec. 1, 1932, p. 639, the government of Holland recently completed 20 miles of dikes cutting off part of the Zuiderzee to form Yssel Lake, intending ultimately to reclaim a large part of the area behind the dike. Two sluices were built into the dike to discharge water from the lake into the North Sea. Abnormally high precipitation in Holland during the early part of the winter resulted in such a high discharge through the sluices as to cause scouring of the ocean bottom beyond the floor of the sluice.

As here shown, a mat is being sunk in front of the Den Oever sluice. It is of similar construction to the mat used to protect the dike from wave action.

Contract Let for Steel Plant to be Built at Detroit

Contract for the construction of the first unit of a new steel plant at Detroit, Mich., has been let by the Rotary Electric Steel Corp., incorporated in Michigan in February of this year. The company will build a plant to utilize the process for the quick conversion of scrap steel into high grade steel billets and bars.

The main mill building is to be of structural steel, 72x1200 ft. on a concrete foundation. Supplementary buildings will include a two-story office building of brick and reinforced concrete construction. The plant site is at Eight Mile and Mound roads, Detroit.

The general contract has been awarded to the Walbridge Aldinger Co., Standard Bldg., Detroit, for the structural steel frame, to R. C. Mahon Co., Detroit, for rotary furnaces, casting machines and special equipment, to the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.

Changes in Engineering Courses Proposed at Rutgers University

Important changes are to be made in the curricula of the College of Engineering at Rutgers University, New Brunswick, N. J., with the opening of the college year next fall. The changes will broaden the base of the student's training in the fundamentals of engineering and economics and will result in less specialization during the four-year course leading to a bachelor's degree. For the student who wishes more specialized training the course provides for a fifth year leading to a master's degree.

The three principles laid down in the preliminary studies for the revised course were (1) provision of a sound foundation in the necessary technical subjects on which the student may build his future professional development; (2) supply the needs of modern industry for recruits capable of rising to positions of leadership both in the administrative and the purely technical branches; (3) train students for life as well as for living by setting up his technical courses in a broad background of cultural studies which will encourage him to develop a philosophy and give him a wholesome appreciation of the social and economic responsibilities of professional engineers in modern civilization.

During the first three years the training of the student in all branches of engineering will be almost identical, the principal exception being the student in sanitary engineering who, because of the large amount of chemistry and biology required, will be given more of those subjects in the junior year to relieve the load on the senior year.

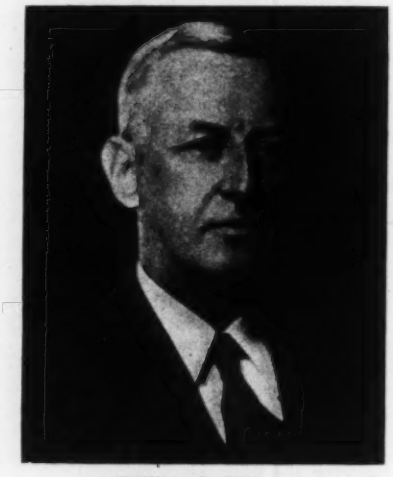
In an attempt to bridge the gap between college preparation and professional work, all engineering students will be required to take a course in social and legal relations of engineers in the senior year.

Although the same training is to be given all students in the first years of their work, special effort is to be made early in the course to orient each student toward a definite objective in order to vitalize the academic experience. Recognition also is to be given to the fact that students fall into two general classes, the analytical type and the executive type, and efforts will be made to direct each to the elective subjects best suited to him.

The plan for the proposed changes in the engineering courses is being carried on under the direction of P. H. Daggett, dean of the college of engineering.

W. P. Wiltsee Elected Head of American Railway Engineers

William P. Wiltsee, chief engineer of the Norfolk & Western Railway, was elected president of the American Railway Engineering Association at its annual meeting held in Chicago on March 14-15. Mr. Wiltsee was born at Cincinnati, Ohio, in 1878, studied engineering at Ohio State University and after three years in various lines of engineering entered the service of the Cincinnati, Portsmouth & Virginia



William P. Wiltsee

R.R., now a part of the Norfolk & Western, as an assistant engineer of construction and maintenance in 1901. Since that time he has been continuously with the Norfolk & Western, successively as draftsman, chief draftsman, assistant engineer with the engineer of branch lines, assistant engineer maintenance and construction, and principal assistant engineer. In February, 1923, he was appointed acting chief engineer and was appointed chief engineer Jan. 1, 1924. From 1912 to 1915 he was in charge of extensive tidewater improvements at Norfolk, Va.

Mr. Wiltsee has been active in engineering society affairs for many years. Since 1907 he has been a member of the American Railway Engineering Association, served as chairman of the committee on track from 1918 to 1924, as a director of the association from 1922 to 1926, and was elected a vice-president in 1931.

Ohio Starts Highway Survey

The state highway department of Ohio has begun a survey along the old canal from a point opposite the state dam at Middletown and continuing to Lockland in Hamilton County as the first step in the building of a super-highway. Work is being rushed in the expectation that it can be completed by the first of May. Engineers laid off by the department have been recalled for this work.

Arthur S. Tuttle Honored

A dinner in horor of Arthur S. Tuttle who recently retired from the position of consulting engineer to the Board of Estimate and Apportionment of New York City after 48 years of service with the city was held at the Engineers Club, New York, on March 20. About 100 engineers were present. Since retirement Mr. Tuttle has been acting as consulting engineer to the Citizens Budget Committee and on the day of the dinner it was announced that he had been named a member of the new city relief administrative board of three.

Washington Notes

By Paul Wooton

Washington Correspondent

President Roosevelt, in his message to Congress on March 21, recommended immediate enactment of legislation creating a civilian conservation corps to be employed on forestry, flood control, checking of soil erosion and like projects. Men of the corps would be paid entirely from unobligated funds now appropriated for public works. President Roosevelt also plans a broad public-works program on which he will submit a message presently.

Highway aid to be pushed

Because of the illness of Representative Edward B. Almon, chairman of the committee on roads of the House of Representatives it seems probable that the work of that committee will be directed by Boliver Kemp. He is expected to insist upon action on a bill authorizing the appropriation of money for federal aid during the next two fiscal years as an essential part of any public works program. For the special session of Congress to adjourn without such action would mean partial disorganization of the state highway organizations, Mr. Kemp points out. Such authorization, he states, will not affect the budget for the coming year but will make it possible for highway commissions to go ahead with their planning so that roadbuilding may play its part in providing employment.

Relief bill reintroduced

In reintroducing his amendment to the Relief Act of 1932 Senator Wagner, of New York, has omitted the limitation placed on the interest that may be charged for funds used for emergency construction. The amendment previously passed by the Senate provided that the interest rate is not to be over one per cent more than that paid by the federal government for the money. Omission of any reference to the interest rate is the only important change in the amendment as reintroduced March 20. Senator Wagner also has reintroduced his bill providing for the establishment of a nation-wide coordinated system of employment offices. Another measure introduced by the New York Senator on March 20 sets up a system of unemployment insurance and wage reserves. Trusts created by an employer, by employees, or by both, or by associations for the purpose of establishing wage reserves are to be exempted from taxation.

Engineers Protest Replacement by Men from Relief Organization

Engineers, architects and technicians formerly in the employ of the several departments of New York City, on March 16 held a mass meeting in the city to protest against the replacement of regular city employees by workers from the rolls of the city relief organizations. It is claimed that men on regular work such as that of the design of school buildings have been laid off and that technically trained men from the list of unemployed have been turned over to the departments to replace them, the new men being paid at the relief work rate.

Oregon Renews Attempt to Obtain Cross-State Railroad Line

In a new attempt to compel the Union Pacific Railroad System to build a new line across the south-central part of the state, the Oregon state legislature before it adjourned passed a resolution directing the state public utilities commission to institute proceedings to compel the railroad to build a line from Burns to Prineville.

In December, 1929, the Interstate Commerce Commission ordered the Oregon-Washington Railroad & Navigation Co., a subsidiary of the Union Pacific System to extend its line from Burns to a connection with the Cascade line of the Southern Pacific Co., at or near Crescent Lake, Ore., a distance of 185 miles. This order was set aside by the Oregon district court and that action was confirmed by the United States Supreme Court on Jan. 9 of this year. (*ENR*, Jan. 12, 1933, p. 68.)

Twelve Companies Submit Bids on Pipe for Denver Water Supply

When bids on the pipe line for the Western end of Denver's proposed supply from the Fraser river and Jim Creek on the west slope of the mountains were opened on March 14, the Columbia Steel Tank Co., of Kansas City, Mo., was found to be the low bidder on each of the alternate proposals of the board of water commissioners. For pipe with ends beveled for field welding or cut and prepared for Dresser couplings, this company bid $142,550, and for pipe belled for field welding, $141,995. Other bidders were the Stearnes-Rogers Mfg. Co. of Denver, $152,959 and $153,310; the Chicago Bridge & Iron Works, $168,581 and $169,115.

Nine other concerns bid on the steel pipe and one company submitted a bid for wood-stave pipe which was not opened.

The pipe line, in sizes of 36, 48 and 50-in. diameter, is to bring water from intakes on the Fraser River and Jim Creek to a shaft leading into the pioneer bore for the Moffat tunnel and through the tunnel past the summit. D. D. Gross is chief engineer of the Board of Water Commissioners.

Because of the unusually mild winter and the light fall of snow, Denver is faced with the possibility of an acute water shortage. As a result, the water board has already sent notices to all water users that the sprinkling of lawns and the use of a hose for washing porches and sidewalks is prohibited until further notice.

SOCIETY CALENDAR

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual convention, Chicago, June 27-30.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Chicago, June 26-30.

AMERICAN WATER WORKS ASSOCIATION, annual meeting, Chicago, June 12-16.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, annual meeting, Chicago, June 27-30.

ENGINEERS WEEK, Century of Progress Exposition, Chicago, June 25-30.

THE MID-SOUTH SECTION of the American Society of Civil Engineers will hold its annual meeting in Vicksburg, Miss., during the first week of May.

THE OHIO ASSOCIATION FOR THE PREVENTION OF CONSTRUCTION ACCIDENTS was organized recently in Columbus, Ohio. Local units are now being organized.

THE MUNICIPAL SECTION, Providence Engineering Society, the Rhode Island Highway Association and the Providence Section, American Society of Civil Engineers, at a joint meeting held at Brown University, were addressed by Prevost Hubbard of the Asphalt Institute on the use of asphaltic products and mineral aggregates in road construction.

THE BOSTON SOCIETY OF CIVIL ENGINEERS, at its 85th annual meeting held in Boston on March 15, elected Arthur W. Dean, chief engineer of the Massachusetts Department of Public Works, president. Harold K. Barrows, professor of hydraulic engineering at Massachusetts Institute of Technology, was elected vice-president, Karl R. Kennison, treasurer and E. N. Hutchins, secretary.

Brief News

A NEW ALL-TIME LOW FIGURE for state and municipal bond issues was established during the month of February. Only $586,000 new issues were approved, according to the Daily Bond Buyer of New York.

TRAINS BEGAN OPERATING over the new elevated Santa Fe railroad line through Oklahoma City early in March but the project will not be completed until next fall. It will provide grade separation for a distance of 2½ miles through the heart of the city.

CONSTRUCTION OF A BRIDGE over the Columbia River at The Dalles, Ore., has been put off at least two years by the failure of the state legislature to pass legislation authorizing the municipal government of The Dalles to increase its indebtedness sufficiently to finance the bridge.

AN EMERGENCY ROAD CONSTRUCTION PROGRAM was approved by the board of supervisors of Niagara County, New York, on March 15. It called for the construction of 12 miles of county highway at a cost of $208,000, in four projects. The work will be carried out by private contract using employees from within the county.

USE OF EMPIRE MATERIALS on government work is specified in an order-in-council recently approved by the Governor General of Canada and all contracts for government work hereafter will call for the use of Empire materials where such materials can be obtained. The order further recommends that the Canadian National Railways and boards or commissions under government control make similar requirements.

ELECTRIFICATION OF THE DOUBLE TRACK railway line between Antwerp and Brussels is to be started this spring by the Beligan Railroad administration, according to a report to the Department of Commerce. Approximately $2,250,000 is to be expended on the work which includes $1,000,000 for electric locomotives.

Personal Notes

JAMES B. TRUE, formerly city engineer, Cheyenne, Wyoming, has been appointed state engineer and T. H. BALDWIN, formerly county surveyor, Laramie County, Wyoming, has been appointed city engineer of Cheyenne, Wyoming.

DANIEL HILLMAN, heretofore engineer of construction, Eastern Lines, Canadian Pacific Railway, has been appointed district engineer of Quebec District at Montreal to succeed J. E. BEATTY, appointed engineer maintenance of way. The position of construction engineer has been abolished.

J. E. BEATTY, heretofore district engineer, Quebec District, Canadian Pacific Railway, has been appointed engineer maintenance of way, Eastern Lines, with headquarters at Montreal to succeed the late A. C. MACKENZIE. Mr. Beatty is a graduate of the Royal Military College, Kingston, Ontario, and has been with the Canadian Pacific Railway continuously since 1904 in various capacities on location, construction and maintenance.

GEORGE E. WARREN, former assistant general manager of the Portland Cement Association, has been appointed vice-president and manager of Eastern operations for the Southwestern Portland Cement Co. with headquarters at Osborn, Ohio. Mr. Warren is a graduate of the University of Illinois in the class of 1912 and was on construction work for the Baltimore Sewerage Commission and as a superintendent of highway construction on Long Island until 1915 when he entered the service department of the Universal Portland Cement Co. After five years there he became secretary of the American Concrete Pipe Association and then, in 1921, he joined the Portland Cement Association as assistant general manager. Since 1932 he has directed the associations' work on the Pacific Coast.

Obituary

WILFORD J. MABIE, formerly construction engineer for the Aberthaw Co., Boston, died at his home in Revere, Mass., on March 14.

HAROLD J. HARDER, former city engineer of Paterson, N. J., and for 12 years a member of the Jersey State Board of Health died at Paterson on March 16.

A. L. DRUM, consulting engineer, Detroit, and former president of the Eastern Michigan Railway, died at his home in Detroit on March 17, age 58. Mr. Drum was a graduate of Massachusetts Institute

of Technology. After graduation he practiced for a time in Boston and then moved to Chicago in 1904, later forming the A. L. Drum Co., consulting engineers, specializing in transit and traffic work.

VICTOR FALKENAU, retired president of the Falkenau Construction Co., Chicago, Ill., died Mar. 12 at Pasadena, Calif., of injuries received when he was struck by an automobile. He was 74 years of age. Mr. Faulkenau was identified prominently with building activities in Chicago, Pittsburgh, Allegheny, Pa., and Gary, Ind. He went to Pasadena to make his home in 1920.

WILLIAM C. UNWIN, noted British engineer and for 30 years professor of engineering at Central Technical College of the Guilds in London, died there on March 17, age 94 years. Professor Unwin was known in this country for his work in connection with the development of power at Niagara Falls and as the author of numerous standard engineering works. He was a past president of the Institution of Civil Engineers and of the Institute of Mechanical Engineers, Great Britain, and an honorary member of the American Society of Civil Engineers.

MORRIS KIND, founder and president of the Hercules Cement Corp., died at his home in Bryn Mawr, Pa., on March 14. Mr. Kind was born in Philadelphia in February, 1875, and graduated from the civil engineering department of the University of Pennsylvania in 1896. He entered the cement industry in 1901 when he assisted in the organizing of the Pacific Portland Cement Co. Subsequently Mr. Kind became general manager, a position he occupied until 1914. In 1916 he undertook the organization of the Hercules Cement Corp. and continued with that company until his death.

BRIG. GEN. HARRY BURGESS, former governor of the Panama Canal, died at the Army and Navy General Hospital at Hot Springs, Ark., on March 18. He had been a patient at the hospital since his return from the Canal Zone in October of last year. General Burgess was born in Starkville, Miss., February, 1872 and graduated from West Point in 1895. Since his graduation his service has been continuously in the Corps of Engineers, including work with the Mississippi River Commission. During the world war he commanded the 16th Engineers (Railway) and soon after his return from France was appointed engineer of maintenance in the Canal Zone. In 1928 he was appointed governor of the Canal Zone.

Contracts and Capital

CONSTRUCTION

(Thousands of Dollars)

	Weekly Average Mar., 1932	Four Weeks	Week Mar. 23 1933
Federal government	$2,487	$2,281	$1,103
State and municipal	7,643	4,289	4,782
Total public	$10,130	$6,530	$5,885
Total private	7,893	5,068	3,499
Week's total	$18,023	$11,598	$9,384
Cumulative to date			
1932		$251,487	
1933		202,298	

NEW PRODUCTIVE CAPITAL

(Thousands of Dollars)

	Weekly Average Mar., 1932	Four Weeks	Week Mar. 18, 1933
R.F.C. loans made	.....	$1,500	.....
New capital issues	$17,200	1,800	$3,700
Total	$17,200	$3,300	$3,700
Cumulative to date			
1932		$314,600	
1933		68,000	
R.F.C. self-liquidating loans:			
Approved current week		.....	
Approved to date (including 1932)		$179,653	
Actual loans made (including 1932)		23,849	

ENR Cost and Volume Index

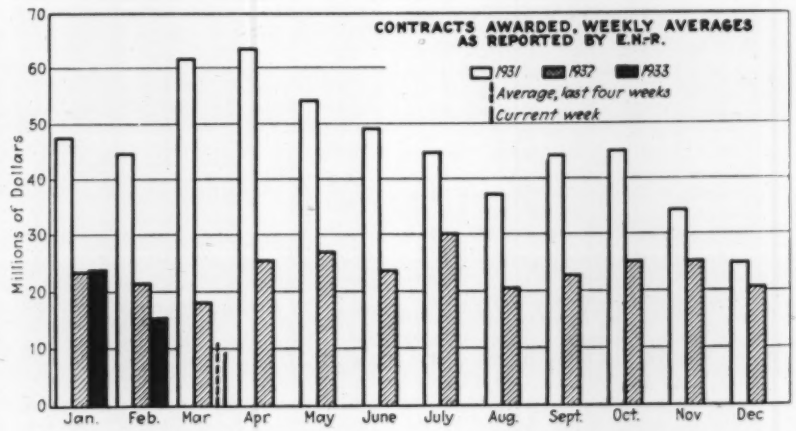
E.N.-R. Cost		E.N.-R. Volume	
March, 1933	158.44	February, 1933	82
February, 1933	159.30	January, 1933	129
March, 1932	157.24	February, 1932	105
1932 (Average)	156.97	1932 (Average)	127
1931 (Average)	181.35	1931 (Average)	220
1930 (Average)	202.35	1930 (Average)	260
1913 Average	100		

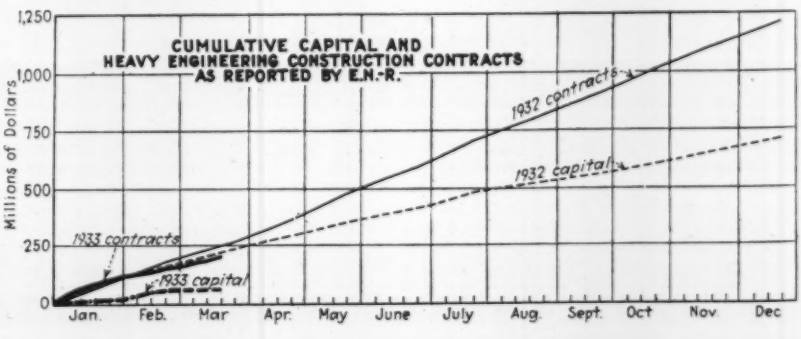
Engineering Contracts and Capital

AWARDS of heavy engineering construction contracts reported for the past week are slightly ahead of the previous week, but continue to show effects of bid postponements resulting from the bank holiday earlier in the month. Last week's total of all awards is $9,384,000, as compared with $8,339,000 the previous week, and an average of the past four weeks of $11,598,000. Cumulative contracts let to date this year are gradually falling behind last year's total, amounting to $202,298,000, as compared with $251,487,000 for 1932. Of last week's awards $5,885,000 represented public works and $3,499,000 was private lettings. In the public works awards, federal contracts amounted to $1,103,000, about half of the previous week's total for this class and less than half of the four-week average. State and municipal contract awards, amounting to $5,885,000, showed a slight gain over the previous week. Highway lettings were average, amounting to $2,522,000. No large single contract awards were reported last week.

Bids will be opened Apr. 4 for the Valverde and Bernasconi tunnels of the Colorado River aqueduct, and on Apr. 17 for the Iron Mountain, Coxcomb and Cottonwood tunnels on the same project. Apr. 4 has been set for receiving bids on three bridges at Richmond, Va., estimated at $1,300,000. Other proposed work of importance includes an apartment hotel in Baltimore, $1,000,000; federal building, Los Angeles, $5,265,000; parcel post building, Detroit, $1,200,000 and a brewery in Cincinnati, $1,000,000. A bill in the New Hampshire legislature calls for a bridge over the Piscataqua River between Dover and Portsmouth to cost about $1,000,000.

The financial situation of the past few weeks is reflected in the low amount of new productive capital issues being sold. Last week the total amounted to $3,672,000, of which $3,000,000 represented one issue, that of Providence, R. I., for streets, sewers and schools. Numerous issues scheduled for sale during the past two weeks found no bidders, prominent in this class being an issue of Oregon state highway bonds aggregating $1,500,000 offered without success on March 15. No new approved loans or additional advances on previous commitments were reported by the Reconstruction Finance Corp. during the week ending March 18.





Current Construction Unit Prices

Complete Unit Bid Prices, Four Contracts on San Francisco-Oakland Bridge

BIDS WERE OPENED Feb. 28, March 2, 7 and 8 on four sections of the San Francisco Bay Bridge. Contracts have not as yet been awarded. The bridge was fully described in *ENR*, Oct. 20, 1932, p. 457. The work is divided into the following general contracts: *Contract 2*—West bay substructure, consisting of four deep-water piers and one deep-water common anchorage to carry two adjacent suspension spans. Bids opened Feb. 28. *Contracts 4 and 4A*—East bay substructure, consisting of 21 piers, mostly in shallow water, between Yerba Buena Island and the east shore. Bids opened March 2. *Contracts 6 and 6A*—Consisting of west bay twin suspension span cables and steelwork, including four towers and common anchorage steel. Bids opened March 7. *Contract 7*—East bay superstructure, consisting of cantilever and truss spans complete. Bids opened March 8. *Contract 5*—Yerba Buena Crossing, consisting of anchorage at east end of suspension spans, viaduct and tunnel crossing the island. Bids postponed to March 28. *Contract 3*—San Francisco anchorage and approach viaduct. Bids postponed to March 29. Unit prices of the first four sections listed above are given in the following. The bridge is being built by the California Toll Bridge Authority, a state agency, with offices at 500 Sansome St., San Francisco.

Contracts 4 and 4A

Bids were submitted by six contractors for contracts 4 and 4A under three schedules as follows: Schedule I, Contract 4, piers E2 to E5, inclusive; Schedule II, Contract 4A, piers E6 to E22, inclusive; Schedule III, Contracts 4 and 4A combined. The lowest combination was bid under Schedule III by Bridge Builders, Inc., San Francisco. Following are complete list of bidders, quantities and unit prices:

BIDDERS AND TOTAL OF EACH BID

Bidders	Schedule	Total Bid
A—Bridge Builders, Inc., San Francisco	III	$4,495,854
B—Connolly, Hanrahan & Pollock, San. Fran	III	4,805,854
C—Bridge Builders, Inc.	I	2,697,246
C—Bridge Builders, Inc.	II	2,034,450
D—Connolly, Hanrahan & Pollock	I	2,984,246
D—Connolly, Hanrahan & Pollock	II	1,846,405
E—Silas Mason Co., San Francisco	I	2,989,158
F—Healy-Tibbitts Const. Co., San. Fran	II	1,922,040
G—San Francisco Bridge Co., San Fran	II	1,999,670
H—Mercer-Fraser Co. & G. R. Cook, Eureka	II	2,185,565

ITEMS, QUANTITIES AND DISCRIPTIONS

Item No.	Quan.	Description
Schedule I, Contract 4, Piers E2 to E5, Inclusive		
1	7,300 cu.yd.	Concrete below E1. 10, pier E2
2	4,960 cu.yd.	Concrete above E1. 10, pier E2
3	143,942 cu.yd.	Caisson excav., piers E3, E4 and E5
4	10,000 cu.yd.	Additional caisson excav., same piers
5	16,000 cu.yd.	Concrete seal, piers E3, E4 and E5
6	8,780 cu.yd.	Concrete above E1. 0, same piers
7	750,000 lb.	Reinforcing steel
8	141,000 lb.	Anchorage steel, all piers
9	lump sum	Reconstruct Army wharf
10	540 M fbm.	Creosoted timber fenders
11	11,000 lin.ft.	Creosoted fender piles in place
12	165,000 lb.	Metal work in fenders
13	1,000 bbl.	Extra portland cement
Schedule II, Contract 4A, Piers E6 to E22, Inclusive		
14	372,000 lin.ft.	Timber piles in place
15	50,000 lin.ft.	Additional length timber piles in place
16	22,000 tons	Gravel blanket
17	61,500 cu.yd.	Concrete seal
18	38,000 cu.yd.	Concrete in pier shafts
19	1,530,000 lb.	Reinforcing steel
20	186,500 lb.	Anchorage steel
21	lump sum	Alterations to Key Route Pier
22	1,000 bbl.	Extra portland cement

COMPLETE UNIT PRICES

Item No.	Unit Prices A	B	C	D	E	F	G	H
1	$10.00	$15.00	$10.00	$15.00	$15.00			
2	30.00	15.00	30.00	15.00	12.00			
3	12.00	16.10	15.00	16.10	15.90			
4	9.00	11.00	9.00	11.00	15.00			
5	10.00	8.00	10.00	8.00	10.00			
6	25.00	14.00	25.00	14.00	10.00			
7	.04	.04	.04	.04	.04			
8	.10	.06	.10	.06	.06			
9	19,000	15,000	19,000	15,000	15,000			
10	80.00	85.00	80.00	85.00	100.00			
11	1.50	1.00	1.50	1.00	1.00			
12	.06	.06	.06	.06	.06			
13	2.00	1.50	2.00	1.70	2.00			
14	.60	.50	.60	.50		$0.80	$1.00	$0.88
15	.35	.15	.35	.15		.20	.40	.50
16	1.25	.70	1.25	.70		.75	1.75	2.00
17	17.00	15.25	18.00	15.65		17.80	15.00	19.65
18	14.00	16.12	14.80	16.12		11.25	15.00	13.28
19	.04	.026	.04	.026		.035	.036	.03
20	.10	.06	.10	.06		.06	.06	.06
21	15,000	10,000	15,000	10,000		9,000	8,400	17,000
22			2.00	1.50		2.00	2.00	2.00

Contract 7

Two unusually close bids were submitted for Contract 7, the superstructure for the east bay crossing spans. The low bid, $8,798,096, was only $143,484 under the second proposal. Complete unit prices follow:

Bidder	Total Bid
A—Columbia Steel Co., San Francisco	$8,798,096
B—McClintic-Marshall Co., San Francisco	8,941,580

Item No.	Quan.	Description	Unit Prices A	B
1	6,800,000 lb.	Nickel steel in spans	$0.0195	$0.0936
2	49,000,000 lb.	Silicon steel in spans	.0675	.0683
3	40,400,000 lb.	Carbon steel in spans	.0635	.0639
4	8,500,000 lb.	Heat treated eyebars	.073	.0763
5	7,050,000 lb.	Silicon steel in bents	.079	.0781
6	4,900,000 lb.	Carbon steel in bents	.0715	.0719
7	50,000 lb.	Manganese steel rivets	.064	.062
8	25,000 lb.	Phosphor bronze	.324	.403
9	12 000 cy.	Concrete paving, top deck	15.75	18.00
10	6,500 cy.	Conc. paving, lower deck	16.75	19.00
11	825,000 l.f.	Reinf. trusses, top deck	.217	.215
12	653,000 l.f.	Reinf. trusses, lower deck	.217	.215
13	2,116,000 lb.	Reinforcing steel	.038	.0425
14	30,500 bbl.	Portland cement	2.10	2.10

Contract 2

Formal bids were submitted by three contractors as follows: *A*—Transbay Const. Co., San Francisco, $6,957,101 (low); *B*—Bridge Builders, Inc., San Francisco, $7,278,-014; *C*—Silas Mason Co., New York and San Francisco, $8,311,653. Complete unit prices follow:

Item	Quan.	Unit Prices A	B	C
Caisson excav., piers 3, 4, 5 and 6, cu.yd.	268,542	$19.54	$17.00	$21.50
Additional caisson excav., same piers, cu.yd.	10,000	15.00	25.00	25.00
Concrete seal, same piers, cu.yd.	55,000	6.25	10.00	8.00
Concrete fdns., pier 2, cu.yd.	21,400	9.35	17.00	15.00
Concrete, pier shafts and fenders, piers 2, 3, 5, 6, cu.yd.	27,000	6.60	12.00	12.00
Concrete, pier 4, cu.yd.	60,500	7.00	12.00	12.00
Reinforcing steel, lb.	3,800,000	.0265	.04	.04
Structural steel, lb.	300,000	.07	.07	.06
Timber in fenders, M ft. b.m.	1,100	63.00	100.00	100.00
Metal work in fenders, lb.	450,000	.085	.08	.08
Extra cement, bbl.	5,000	2.00	2.00	2.20

Alterations to harbor pier No. 4: A — $175,000; B — $170,000; C — $150,000.

Contracts 6 and 6A

Four bids were submitted by three firms under three schedules for Contracts 6 and 6A, superstructure of the twin suspension spans of the west bay crossing. The schedules are as follows: Schedule I—Superstructure except cables and attachments, Contract 6; Schedule II—Cables and attachments, Contract 6A; Schedule III—Contracts 6 and 6A combined. The lowest combination was a bid submitted under Schedule III by the Columbia Steel Co. Complete unit prices follow:

BIDDERS AND TOTAL BIDS

Bidders	Schedule	Total Bid
A—Columbia Steel Co., San Francisco	III	$13,732,472
B—Columbia Steel Co.	I	9,566,431
B—Columbia Steel Co.	II	4,625,977
C—McClintic-Marshall Co., San Francisco	I	9,693,157
D—John A. Roebling's Sons Co., San Fran.	II	4,812,116

COMPLETE UNIT PRICES

Item No.	Quan.	Description	Unit Prices A	B	C
Contract 6					
1	37,000,000 lb.	Silicon steel in towers	$0.0764	$0.0775	$0.0749
2	10,000,000 lb.	Carbon steel in towers	.0729	.0738	.0706
3	1,200,000 lb.	Cast steel in towers	.1112	.1125	.1383
4	700,000 lb.	Heat treated eyebars	.0845	.0845	.0920
5	510,000 lb.	Carbon steel eyebars	.0652	.0652	.0681
6	560,000 lb.	Nickel steel	.1044	.1044	.1101
7	48,000,000 lb.	Silicon steel susp. struc.	.0631	.0637	.0656
8	29,000 lb.	Carbon steel susp. struct.	.0597	.0603	.0619
9	300,000 lb.	Cast steel suspended struct.	.1023	.1023	.1210
10	600,000 lb.	Manganese steel rivets	.0573	.0573	.0609
11	50,000 lb.	Phosphor bronze	.3270	.3270	.3385
12	11,600 cy.	Concrete pave., light wt.	15.75	15.75	18.50
13	6,300 cy.	Concrete pavement, std.	15.75	15.75	19.20
14	815,000 lf.	Reinf. trusses, top deck	.2170	.2170	.2220
15	625,000 lf.	Reinf. trusses, lower deck	.2170	.2170	.2220
16	2,200,000 lb.	Reinforcing steel	.037	.037	.044
17	2,200 cy.	Concrete center anchorage	18.41	18.40	14.50
18	33,000 bbl.	Portland cement	2.10	2.15	2.10
Contract 6A			A	B	D
19	37,400,000 lb.	Cable wire	.1002	.1085	.1170
20	1,660,000 lb.	Cable castings	.1196	.1315	.1100
21	226,000 l.f.	2¼-in. suspender ropes	1.39	1.28	.94
22	38,100 l.f.	1-in. hand rope	.2680	.3040	.3600
23	150,000 lb.	High tensile strength bolts	.1028	.1104	.1000
24	33,000 lb.	Wrought shims	.0725	.0746	.0700
25	41,000 lb.	Galvanized cable fastenings	.1212	.1231	.2500

Prevailing Wages

On all of the above work the contractors will be required to pay prevailing wages. The rates now prevailing as determined by the Toll Bridge Authority are given below. Five days will be considered as a week's work, with 30 hours specified as the maximum any other than those in a supervisory capacity shall work in any one week. The wages listed below are for an 8-hour day. Less than 8 hours will be paid for on a proportional basis, 6 hours being the minimum. Double time will be paid for holiday and Sunday work, except, that in working three continuous shifts, in lieu of double time, contractors will be permitted to pay stipulated wages for 8 hours for 7 hours of work.

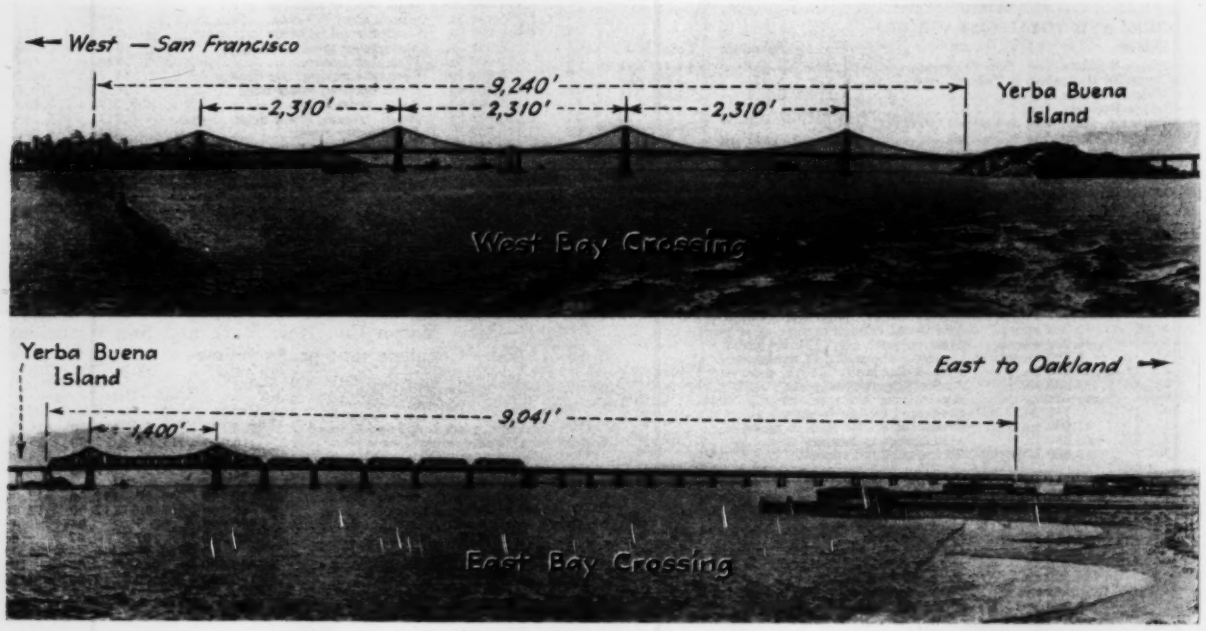
Craft	Per Diem Wage 8 Hours Work
Carpenter	$8.00
Caulker	8.00
Pile driver engineer	10.00
Pile driver	9.00
Ironworker (bridge and structural, rigger	11.00
Ironworker (reinforced concrete), rodman	9.00
Plumber	10.00
Electrical worker	9.00
Steam fitter	10.00
Laborer	5.50
Engineer (on compressors)	10.00
Engineer (hoisting and portable)	9.00
Engineer (structural steel)	11.00
Machinist	9.00
Painter	9.00
Truck driver (less than 2,500 lbs)	6.00
Truck driver (2,500 to 4,500 lbs.)	6.50
Truck driver (4,500 to 6,500 lbs.)	7.00
Truck driver (over 6,500 lbs.)	7.50
Powderman	7.00
Drill runner	7.00
Diamond setter	$250.00 per month
Watchman (no overtime for Saturdays or holidays)	$5.00 per diem wage

Power Launch and Tugboats	Per Month Wage
*Operators for boats up to 20 hp	$125.00
*Operators for boats 21 to 30 hp	145.00
*Operators for boats 31 to 65 hp	160.00
*Operators for boats 66 to 135 hp	175.00
*Operators for boats 136 to 200 hp	190.00
*Operators for boats 201 to 250 hp	200.00
*Operators for boats over 250 hp	250.00
Captains of steam tugs	250.00
Engineers of steam tugs	225.00
Marine deckhands and firemen	150.00

For employees on a per diem basis, overtime one and one-half (1½) times above rate.

Rate for any employee not covered in the above schedule shall be at a rate of not less than $5.00 per diem.

* Includes sustenance while on duty.



San Francisco Bay Bridge connecting San Francisco and Oakland. West bay crossing will be twin suspension spans of 2,310 ft. each, with side spans of 1,155 ft. East bay crossing will consist of cantilever span of 1,400 ft. with 511-ft. anchor arms; five 509-ft. through truss spans; and fourteen 291-ft. deck truss spans. Route crosses Yerba Buena Island in mid-bay partly on trestle and partly through double deck tunnel. Viaduct approach at San Francisco end and fill approach at Oakland end complete the structure, which will be about 7½ miles in length. Double deck construction throughout will provide for vehicular and rapid transit traffic. (Illustrations from artist's sketch).